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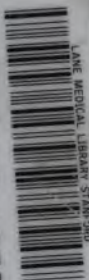
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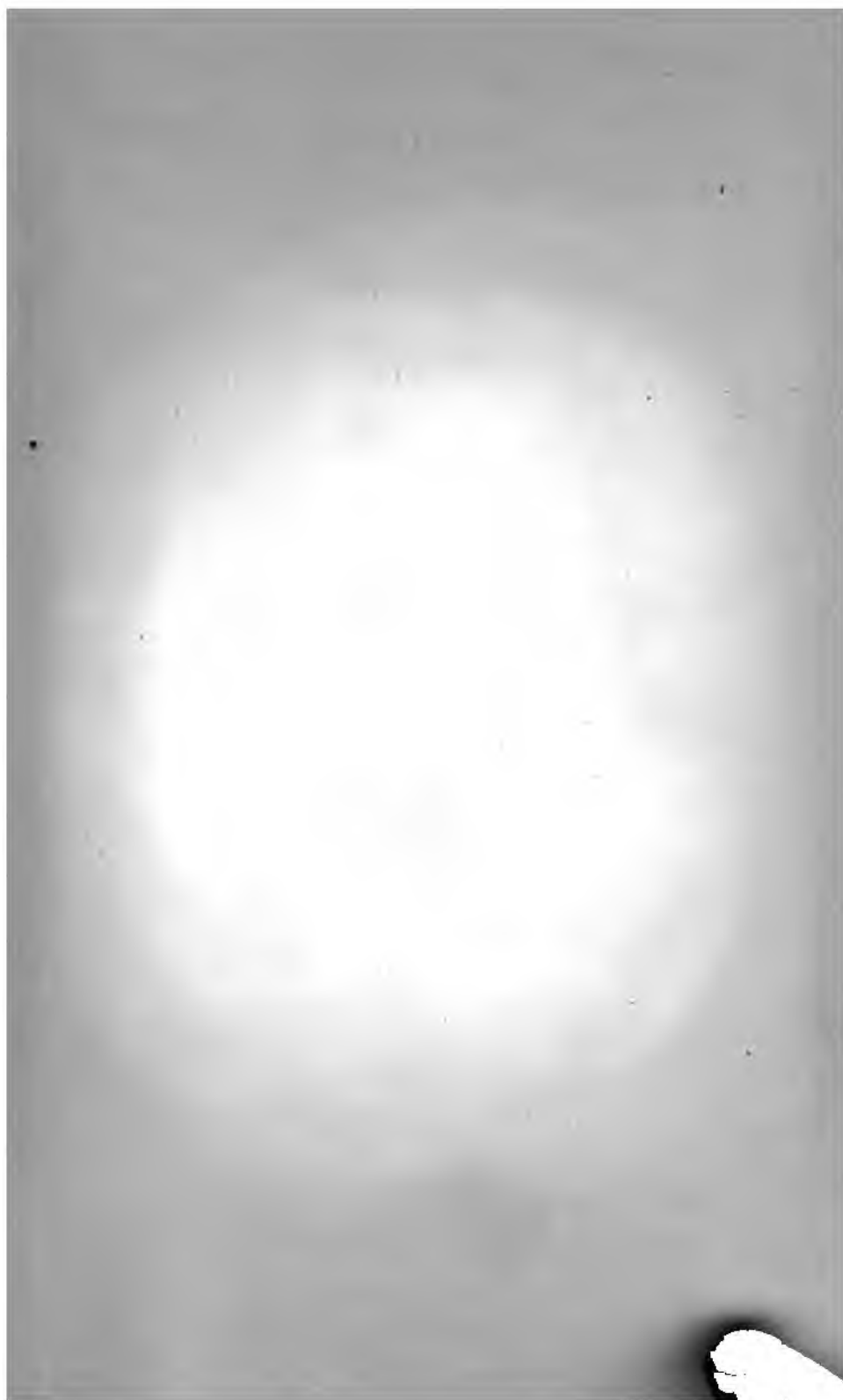
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# INTRACRANIAL TUMORS AMONG THE INSANE.

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## A STUDY OF TWENTY-NINE INTRACRANIAL TUMORS FOUND IN SIXTEEN HUNDRED AND FORTY-TWO AUTOPSIES IN CASES OF MENTAL DISEASE,

BY

I. W. BLACKBURN, M. D.,

*Pathologist to the Government Hospital for the Insane, Washington, D. C.*



ILLUSTRATED BY THIRTY PLATES AND SIXTY-FIVE  
MICROSCOPICAL DRAWINGS.

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## LETTER OF SUBMITTAL.

GOVERNMENT HOSPITAL FOR THE INSANE,  
*Washington, D. C., April 7, 1903.*

SIR: I have the honor to transmit herewith a special report of the pathologist of this hospital, including text, plates, and photographs, as contemplated at the time of the submission of the annual report of the Board of Visitors. This report includes a synopsis of all the cases of brain tumors developed at the hospital during the term of service of the present pathologist, and will be of great interest and value to neurologists and specialists in diseases of the brain. I respectfully request its publication in the interest of science as a portion of the regular report from this hospital. This portion was deferred at the time of the submission of the annual report until the necessary data could be procured and put in shape for publication.

Very respectfully,

A. B. RICHARDSON,  
*Superintendent.*

The Honorable SECRETARY OF THE INTERIOR,  
*Washington, D. C.*

DEAR SIR: I have the honor to submit to you the work on intracranial tumors prepared for publication by your permission and under your direction.

The work consists of a compilation of the reports of cases of intracranial growths which have been published in the pathological supplements to the annual reports of the hospital during my term of service, with the addition of two cases of brain tumor studied during the past fiscal year.

Five photographic plates and 11 microscopical drawings are herewith submitted for reproduction by photo-engraving process, and 25 half-tone plates and reproductions of 54 microscopical illustrations are in the possession of the hospital ready to convey to the printer.

Trusting that the work may meet with your approval, and with many thanks for your support and assistance, I am,

Very respectfully,

I. W. BLACKBURN, M. D.,  
*Pathologist.*

Dr. A. B. RICHARDSON,  
*Superintendent Government Hospital for the Insane.*



## A STUDY OF TWENTY-NINE INTRACRANIAL TUMORS, FOUND IN SIXTEEN HUNDRED AND FORTY-TWO AUTOPSIES IN CASES OF MENTAL DISEASE.

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### INTRODUCTION.

In this study of intracranial growths the subject has been considered mainly from the standpoint of morbid anatomy and pathological histology. Occurring as they did among the insane, the clinical histories are often very deficient. In some cases the patients were greatly demented on admission and could give no clear subjective symptoms; in some, the symptoms of brain tumor were obscured by predominating mental manifestations, and in others the growths were small and probably gave rise to no physical nor mental disturbances. In several cases the presence of intracranial growth was recognized by the characteristic symptoms, but in these cases it was not deemed wise to operate; and in most instances it was found that either the size of the growth, its nature, or its situation would have precluded an operation. Some of the dural growths might have been removed if they had been discovered while the tumors were small and had not penetrated and seriously damaged the brain. It is this that gives interest to the study of several of these small growths, otherwise of little importance to the clinician. Owing to the slow growth of these tumors and that they penetrate the brain mechanically a certain degree of tolerance is attained by the organ, and unfortunately such growths may reach considerable size before their presence and location are recognizable by brain symptoms. These tumors are, however, by all means the most favorable for operation, as they do not infiltrate the brain substance, they are sharply circumscribed, easily enucleated, and if removed would not recur. Of the twenty-eight true tumors found, seventeen may be regarded as belonging to this class of growths properly called spindle-celled endothelial sarcomata, usually of the dura mater. They originate as small wart-like growths from the inner surface of the dura mater and when favorably situated for operation may be easily removed, in many cases with safety and the preservation of mental health.

Other growths which invade the brain tissue and replace its elements by infiltration such as the ordinary forms of sarcoma and the gliomata can only be removed by sacrifice of the portion of the brain involved, and such operations can scarcely be regarded as either safe or promising. For this reason some of the tumors studied could not have been removed even if surgical interference had been attempted. This study has, for the reasons given, mainly to do with the morbid anatomy and histology of these growths, and to facilitate the descriptions 30 plates and 65 microscopical drawings have been introduced to illustrate the intracranial tumors and the morbid growths with which they were in several instances associated.

The microscopic fields selected were those best illustrating the general character of the growth; in some this was possible in a single drawing; in others several illustrations were necessary to show the



modifications of the tumor structure. In the cases of adenoma of the hypophysis, drawings of the normal glands were given for comparison with the tumor tissue and several fields from the latter were introduced to show slight variations in histology in different parts.

Especial attention has been paid to the illustration of the several varieties of endothelial sarcomata, and the drawings and cases have been arranged to show the origin and development of the peculiarities of structures which make these growths so interesting and so complex.

The gliomata have been represented by a number of drawings from typical fields and from some of the modifications of structure to which these complex tumors are subject. In the writer's opinion these growths can no longer be regarded as simple tissue tumors. According to the recent and accepted views as to the blastodermic origin of the neuroglia, we have in this tumor tissue ectodermic elements in the glia cells and fibrils, and mesodermic derivatives in the blood vessels and their accompanying fibrous investments. The result is a compound tissue tumor with complex interrelations not yet fully investigated.

The ordinary sarcomata are represented by a single tumor, a round celled sarcoma, which probably originated as an angio-sarcoma of the pia mater; and on the border line between the gliomata and sarcomata may be placed the tumor represented by fig. 53, case 820. This tumor was called a glio-sarcoma, but it may be with equal propriety regarded as a small-celled glioma.

The specific granulomata are represented by a case of multiple tubercular tumors of the brain and extensive deposits in the lungs, vertebræ, and elsewhere. Tubercular disease of the brain and meninges has been infrequent in my autopsies, as most of our patients are adults. Gross syphilitic disease of the central nervous system is also rare, and it is perhaps worthy of remark in this connection, that in over 1,700 autopsies, I have never found any syphilitic growth of the brain which could be dignified by the name of tumor or gumma.

Three growths were found within the pituitary fossa; two of which involved the pituitary body and one occupied the fossa and greatly enlarged it, but did not affect the gland. In none of these cases were there any evidences of acromegaly. Two of these tumors were adenomata of the hypophysis, and the nature of the third could not be determined on account of degeneration. The more rare forms of intracranial growths have not been found in my autopsies, and no secondary deposit have occurred in the brain from the malignant tumors of other organs. In several cases tumors of different character coexisted with growth of the brain and dura mater, and in one instance three tumors of different structure were found in the same subject.

Osteomata in the form of exostosis of the inner table of the skull and small irregularly shaped, flat bone masses, usually of the falx have been quite common. The possible relation of these growths to inflammatory diseases and to congenital errors of development would exclude them from the true neoplasms.

The writer wishes here to express his thanks to his professional friends whose appreciation of his work prompted the invitation to publish it in this form; and to Dr. A. B. Richardson, superintendent of the hospital, for his encouragement and support, without which the work could not have been accomplished.

GOVERNMENT HOSPITAL FOR THE INSANE,  
*December 31, 1902.*

PLATE I.



Case 853. Tumor of brain. Spindle-celled sarcoma.





Case 842. Tumor of brain. (Photograph reversed.) Spindle-celled endothelial sarcoma.





Case 842. Tumor of brain. (Photograph reversed.) Spindle-celled endothelial sarcoma.







Case 774. Tumor of brain. (Photograph reversed.) Spindle-celled endothelial sarcoma.

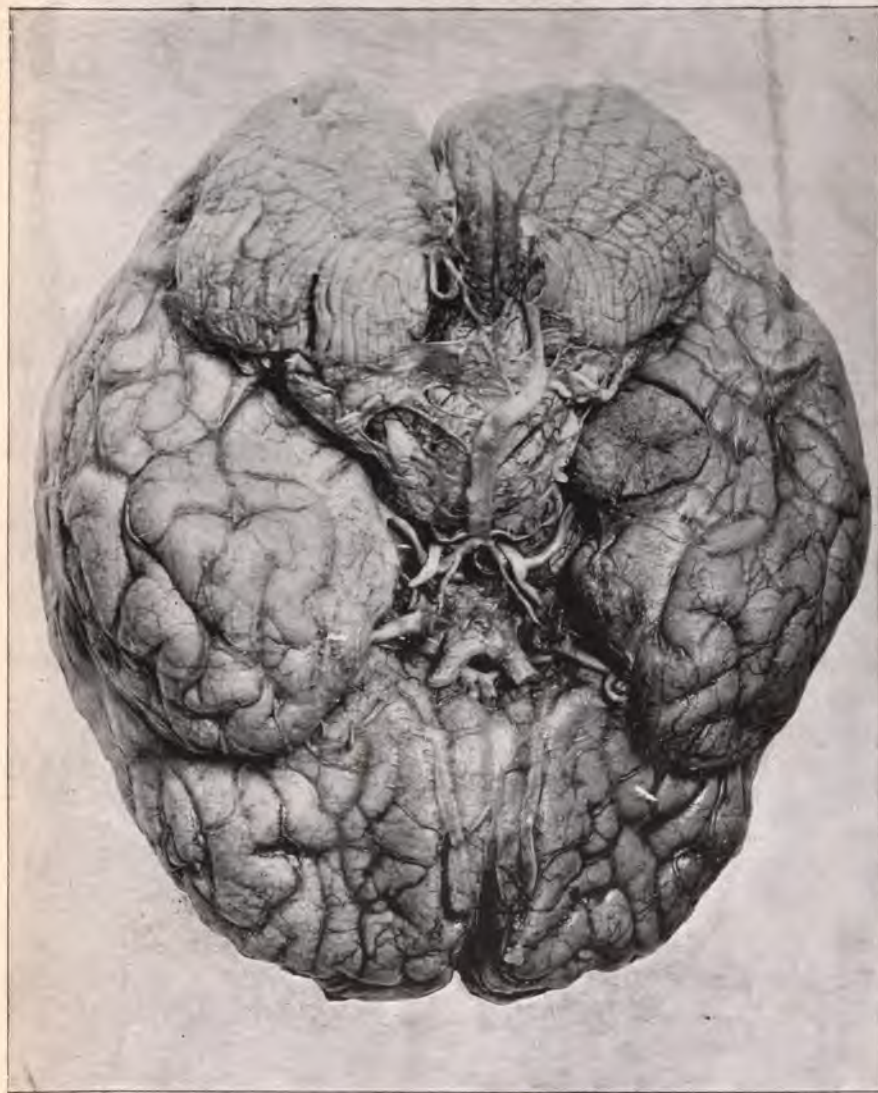






Case 1146. Soft cancer of the pyloric end of the stomach. The growth coexisted with tumor of dura mater illustrated by microscopical drawing fig. 12.





Case 965. Tumor of brain (Photograph reversed.) Degenerated spindle-celled sarcoma, or psammoma; probably of the dura mater.



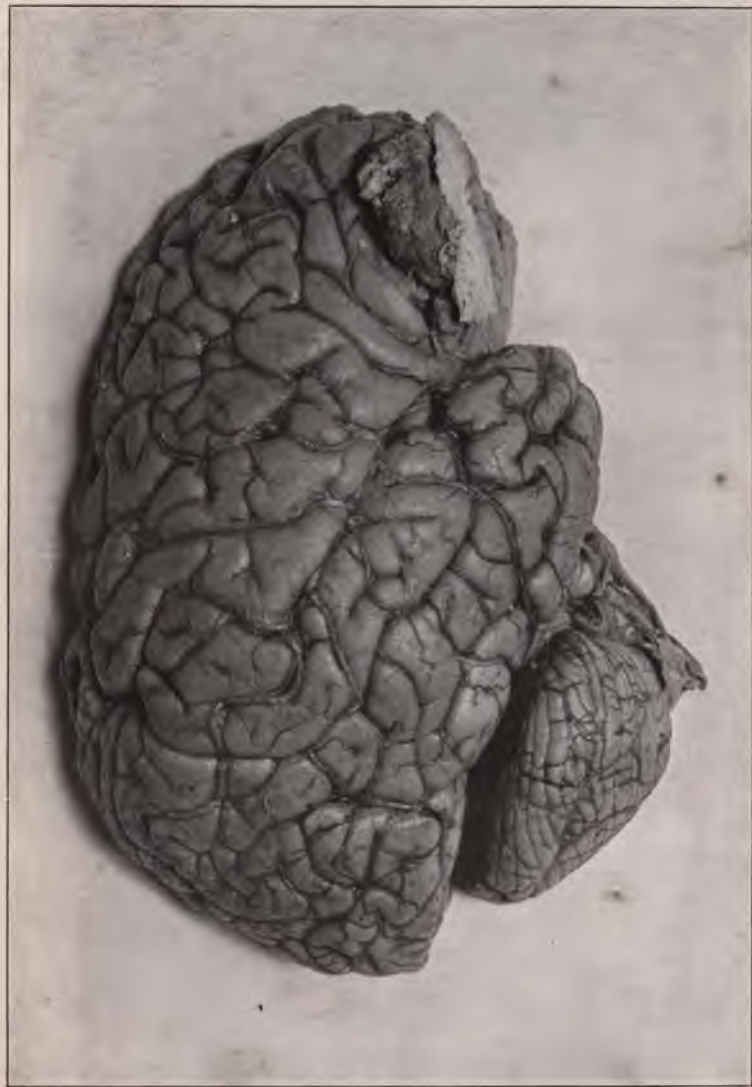
PLATE VII.



Case 965. Section of brain showing tumor in temporal lobe.



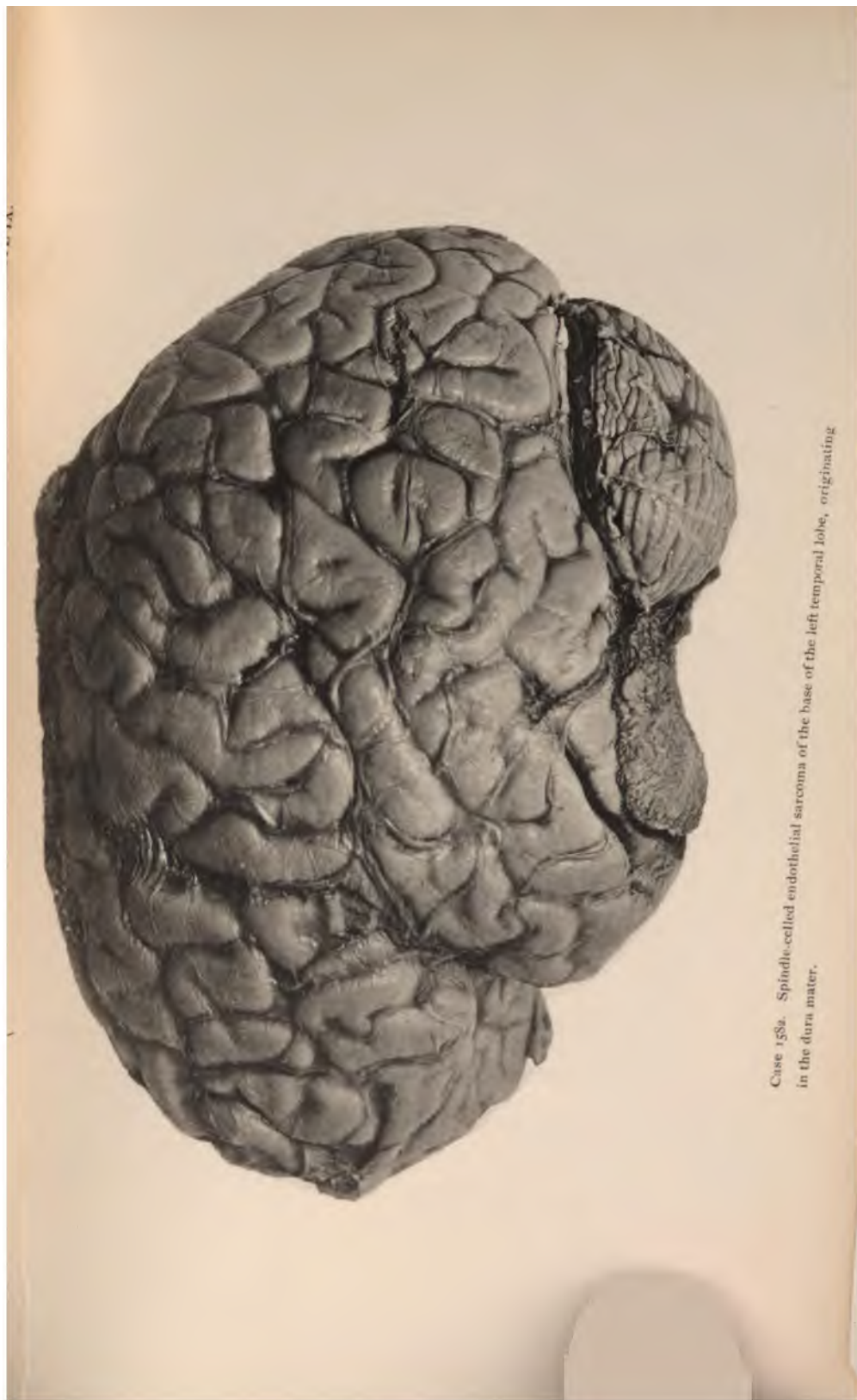




Case 1503. Spindle-celled endothelial sarcoma of the dura mater penetrating the brain.



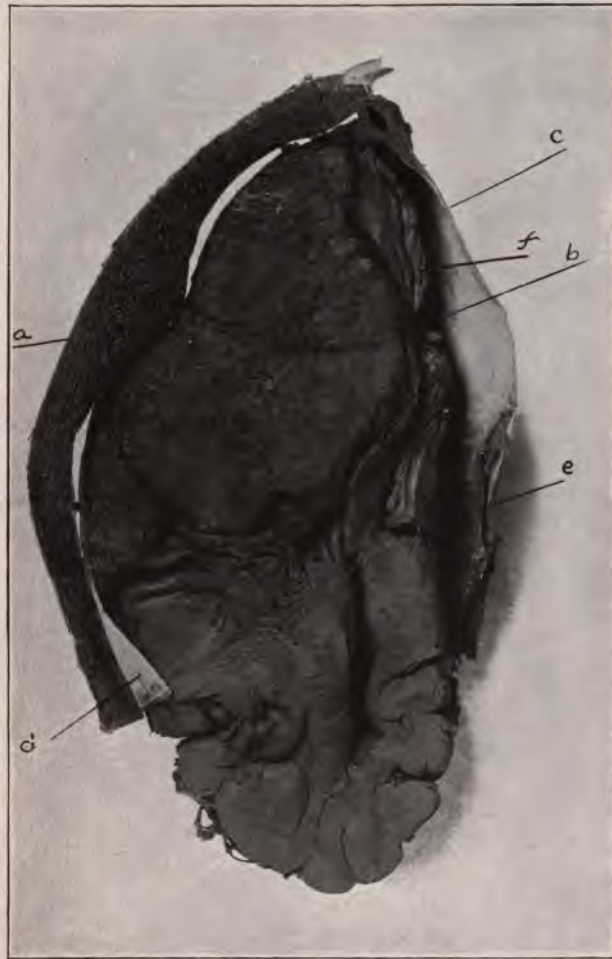




Case 158a. Spindle-celled endothelial sarcoma of the base of the left temporal lobe, originating in the dura mater.



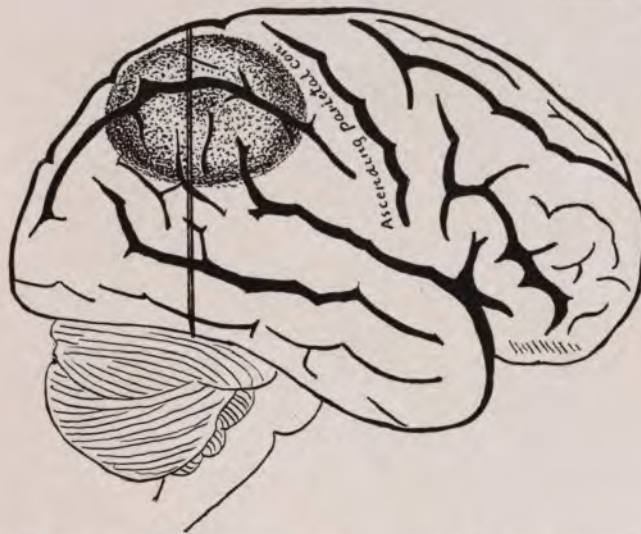
PLATE X.



Case 1178. Spindle-celled sarcoma of the brain. The plate shows a transverse section through the middle of the tumor, the overlying skull, dura, falx, and tentorium. The protuberance of the bone, the depression in the surface of the tumor, and the invasion of the brain by the tumor are shown by this section. *a*, skull bone; *b*, tumor; *c*, falx cerebri; *d*, dura mater; *e*, tentorium; *f*, thin layer of brain tissue of median surface of hemisphere.



PLATE XI.



Case 1178. Diagram showing the situation of the tumor and the place of section shown in Plate X.







Case 1130. Tumor of cerebellum. Inferior view. Hemorrhagic spindle-celled sarcoma.

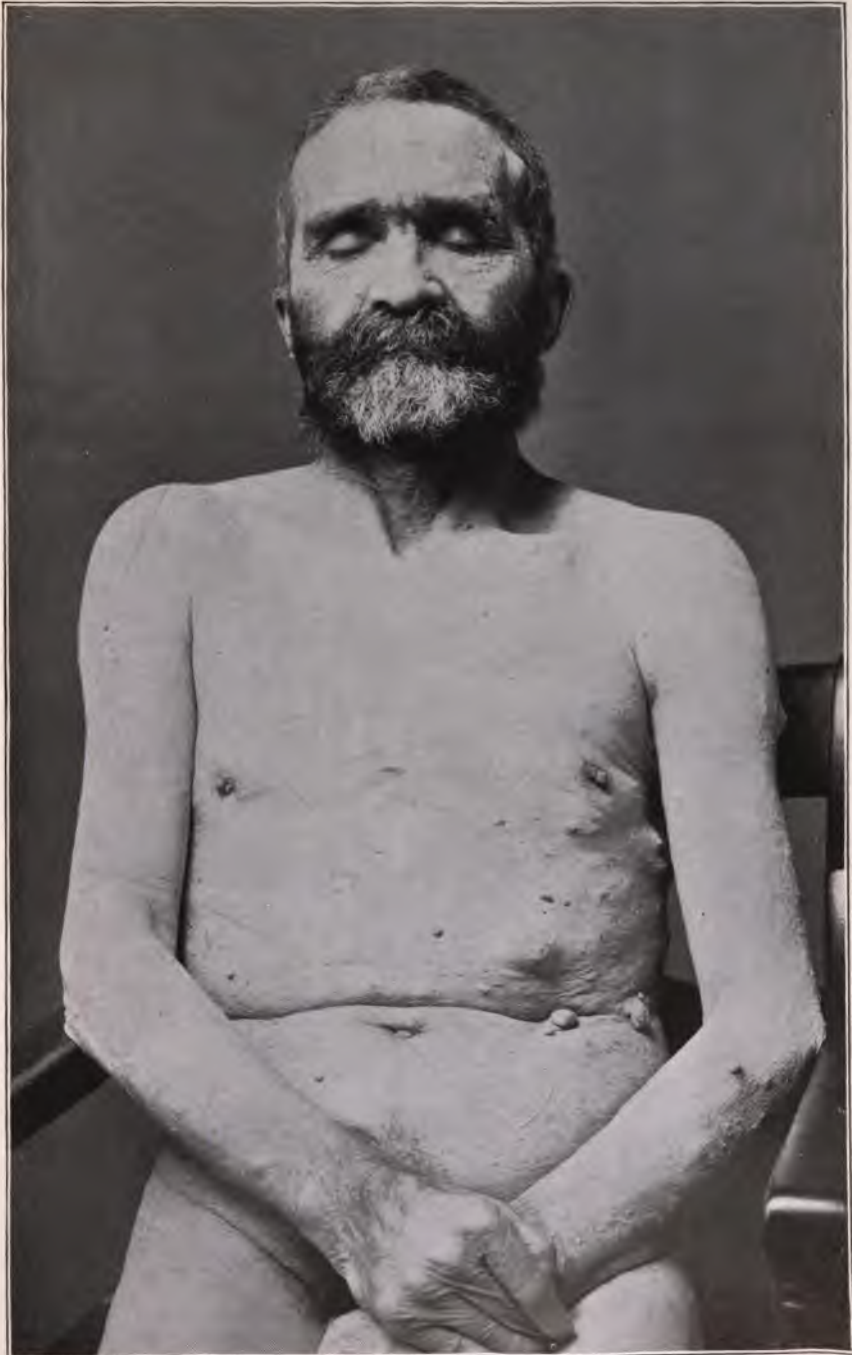






Case 1130. Tumor of cerebellum. Superior view. Hemorrhagic spindle-celled sarcoma.





Case 1130. Multiple soft fibromata of the skin. These tumors of the skin coexisted with hemorrhagic spindle-celled sarcoma of the cerebellum.





Case 1053. Glioma of corpus callosum and frontal lobes. Reduced 1/2.



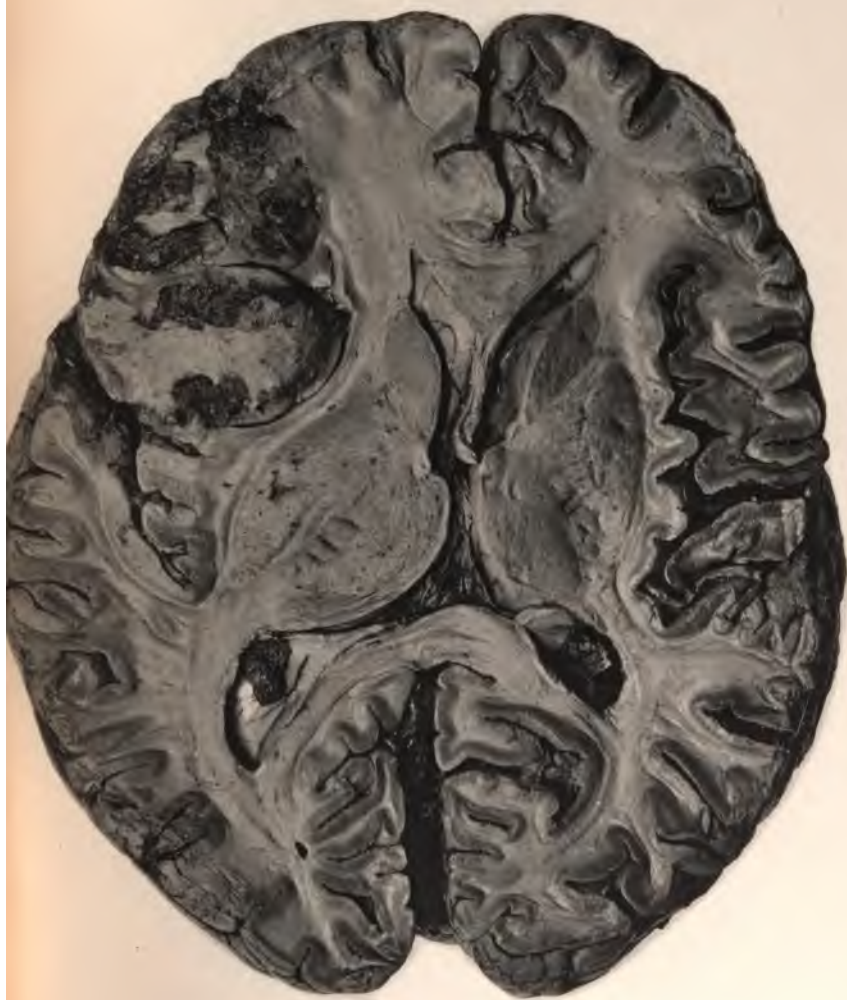




Case 1426. Section of brain showing glioma of left frontal lobe. *a*, Portion of cyst in the interior of the tumor.  
The dotted line indicates the apparent boundary of the tumor.

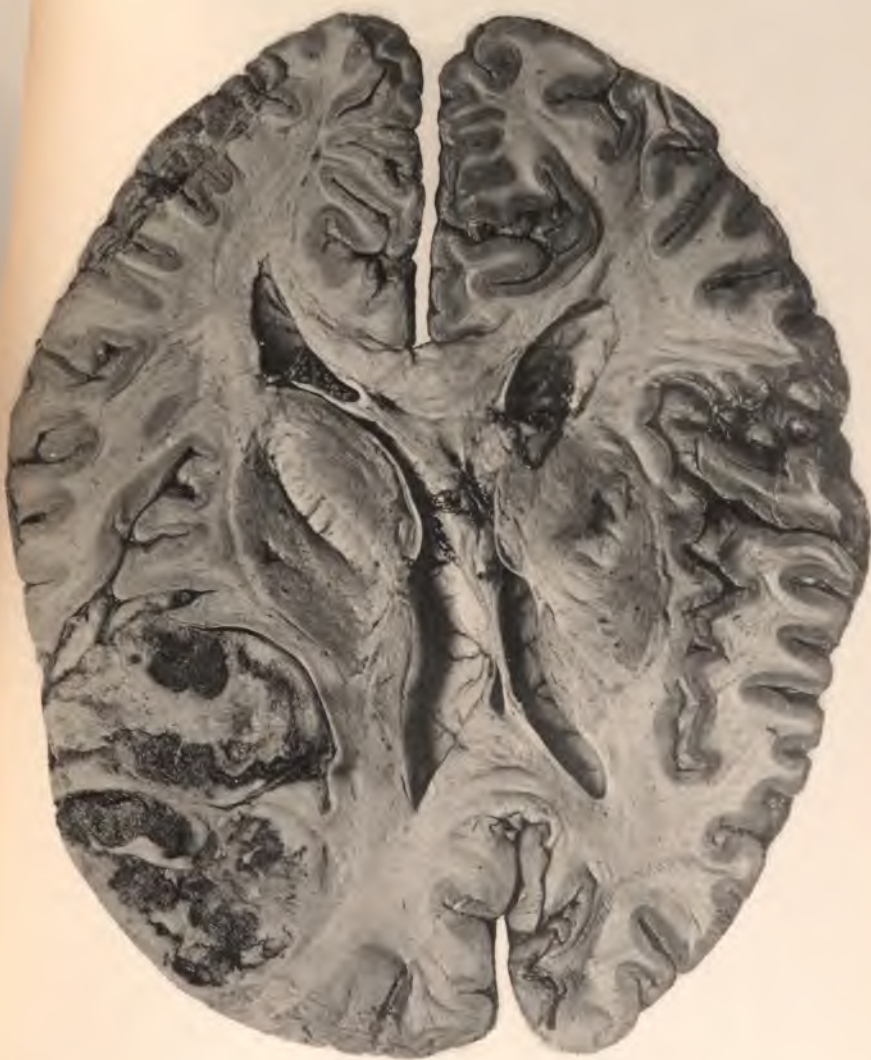






Case 1619. Glioma of the left frontal lobe. Lower half of brain shown by horizontal section extending through the middle of the tumor. The dark areas are degenerated and hemorrhagic portions of the growth.





Case 1619. Glioma of left frontal lobe. Upper half of brain shown by horizontal section.



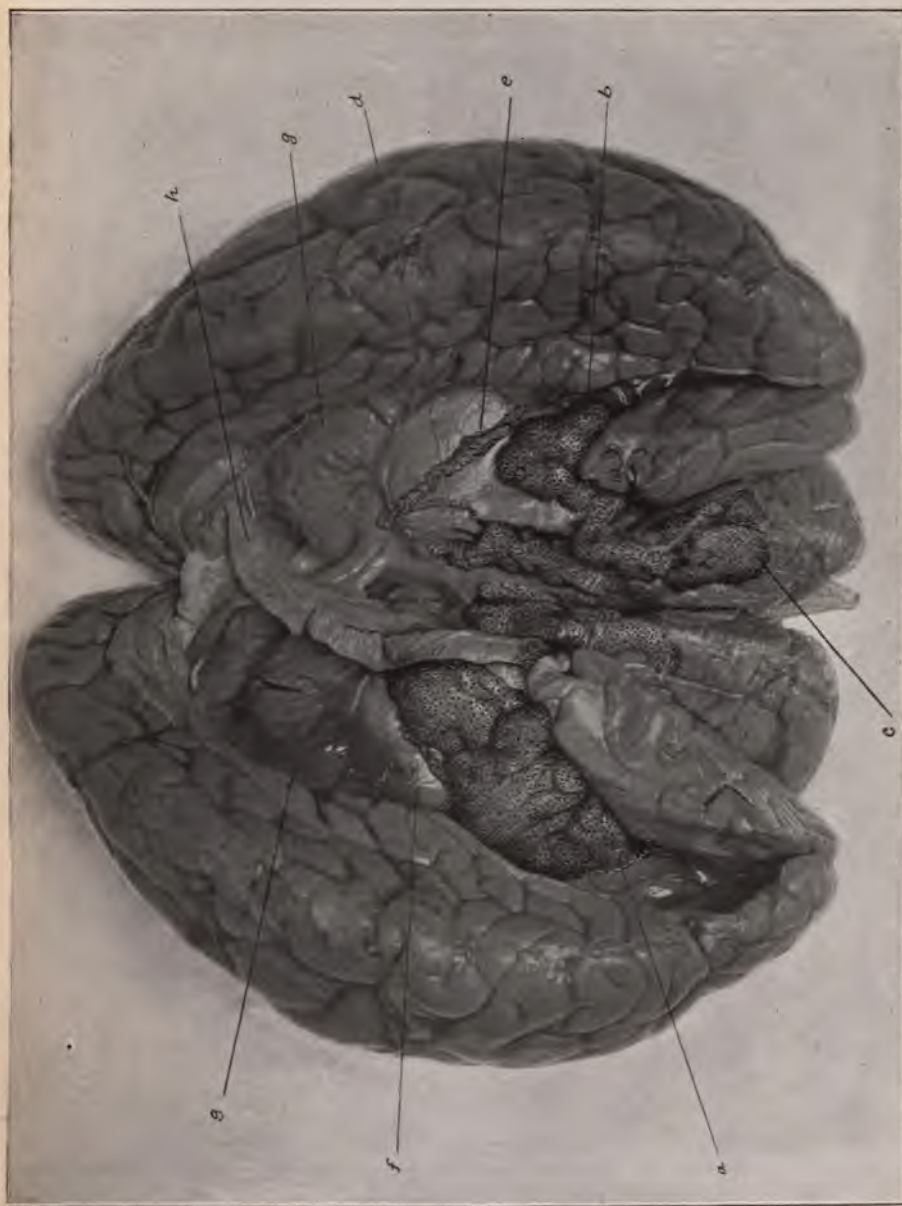


PLATE XIX.

Case 829. Tumor of brain. (Photograph reversed.) Glioma of left temporal lobe. The photograph was taken by a process which reversed the object.



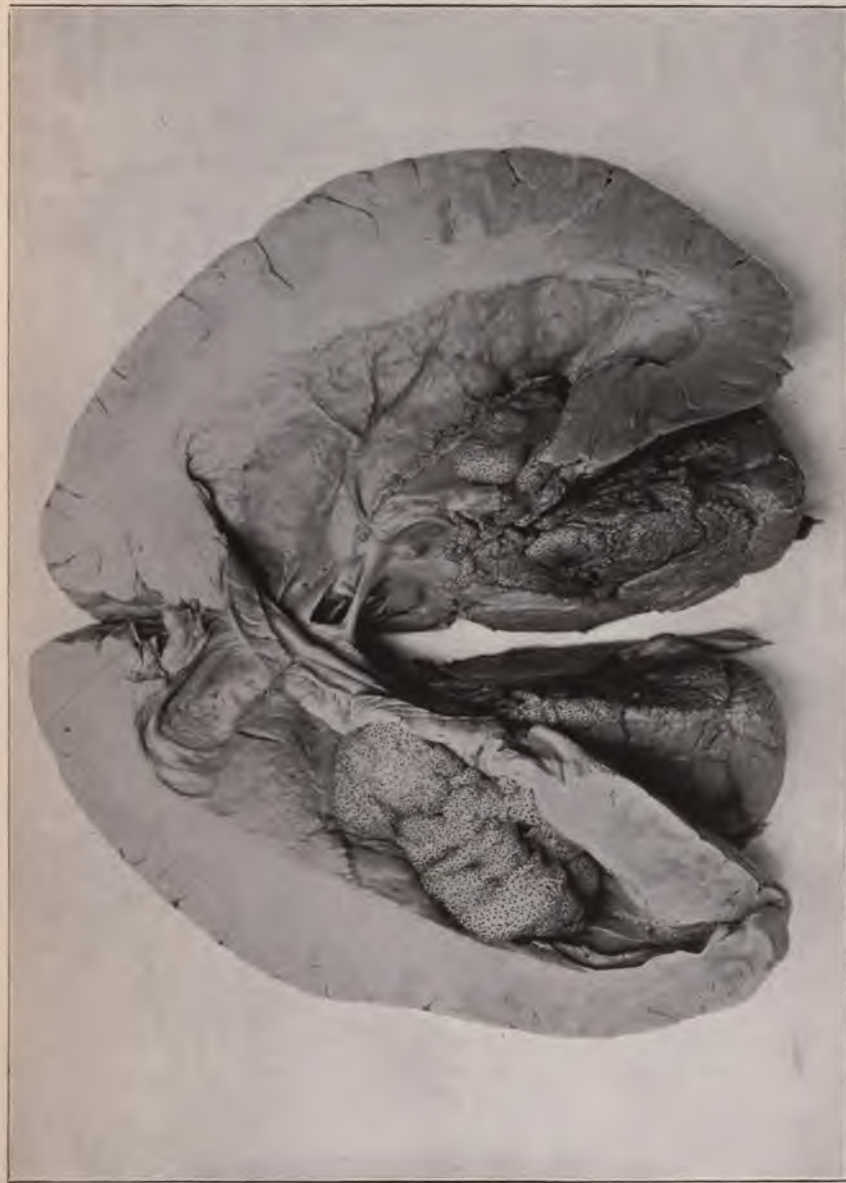




Case 1237. Round-celled sarcoma of the brain. *a*, *b*, Tumor masses within the posterior horns of the lateral ventricles; *c*, tumor masses in the cerebellum; *d*, tumor masses invading the walls of the third ventricle; *e*, choroid plexus of the lateral ventricle; *f*, thalamus; *g*, caudate nucleus; *h*, cut edge of corpus callosum. The tumor masses are dotted to distinguish them from the brain tissue.







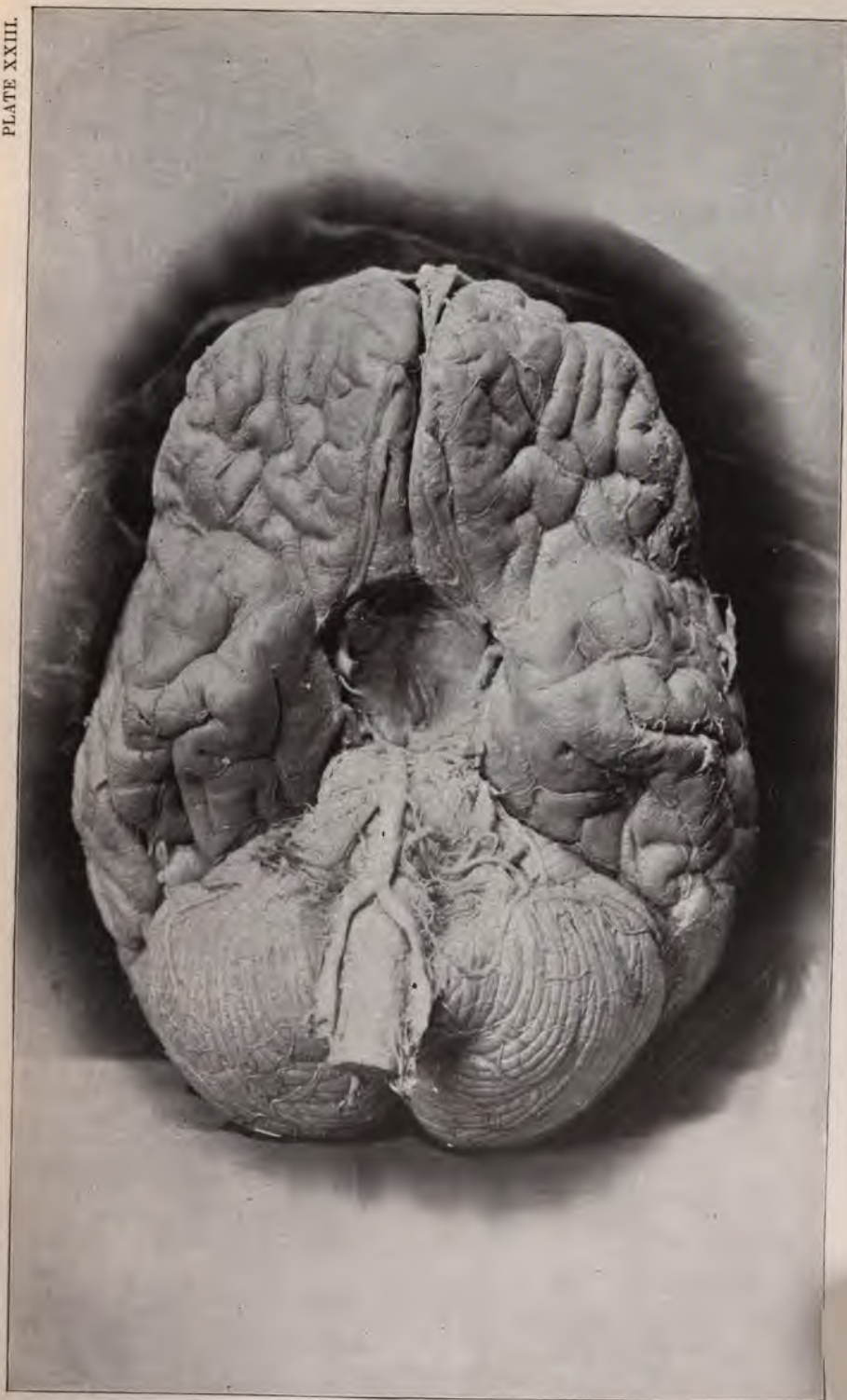
Case 1237. Round-celled sarcoma of the brain. The superior portions of the hemispheres are removed, and a median section made to show the extent of the growth in the ventricles, corpora quadrigemina, and cerebellum. The tumor masses are dotted to distinguish them from the brain tissue.





Case 788. Tumor of pituitary body. (Photograph reversed.)





Case 788. Depression made by the tumor of the pituitary body.







Case 870. Tumor of the pituitary body.





PLATE XXV.



PHOTO DRG CO. N.Y.

Case 870. Median section of brain and adenoma of pituitary body.



PLATE XXVI



Case 991. Tubercular tumor of cerebellum.





Case 806. Aneurism of middle cerebral artery. (Photograph reversed.)







Case 805. Dissection of aneurysm of middle cerebral artery, of right side.







Case 1246. Colored female, aged 65, mental disease, dementia, probably always mentally defective. Hyperostoses of the inner surface of the frontal bone of a scaphoid calvaria. The bone is much thickened, nodular and irregular almost to the coronal suture, and the diploe is abundant and coarse. The sagittal suture was completely united.

Diameters  $8\frac{1}{2}$  by  $5\frac{1}{4}$  inches.





Groups of small osteomata found mainly in the falx. The specimens are photographed full size and the one in the centre, still connected with a portion of the falx, is the largest I have ever found. Such growths as this may cause slight depressions in the adjoining brain surfaces.



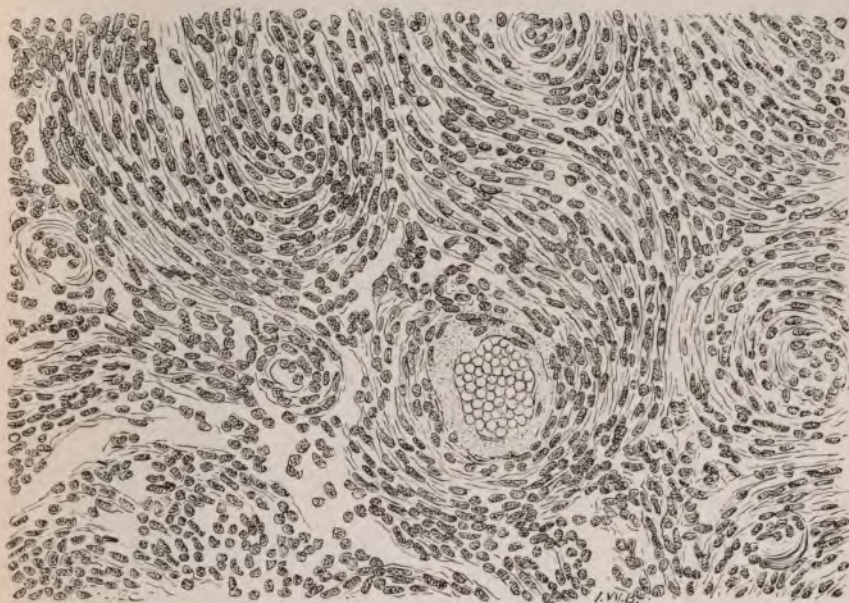


Fig. 1. Case 853. Spindle-celled sarcoma of brain.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)

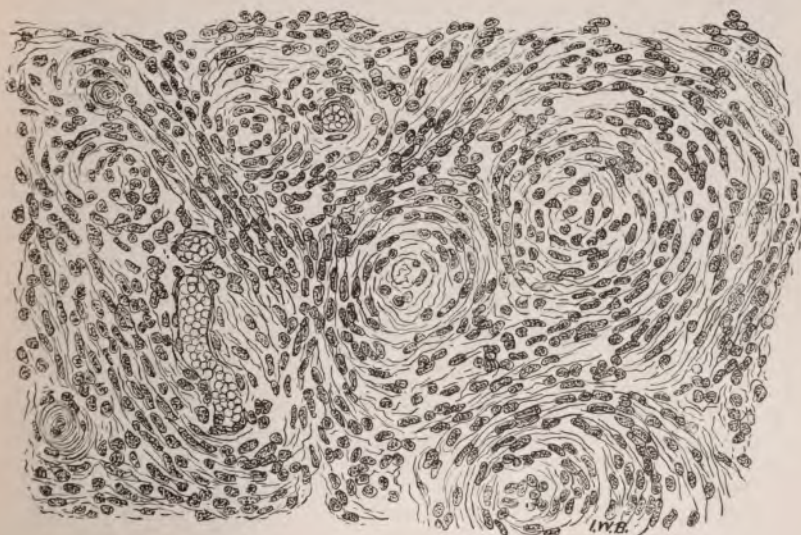


Fig. 2. Case 853. Spindle-celled sarcoma of brain.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)





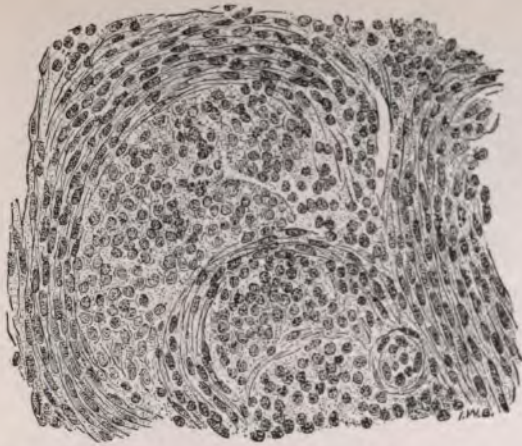


Fig. 3. Case 842. Spindle-celled sarcoma of dura mater.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

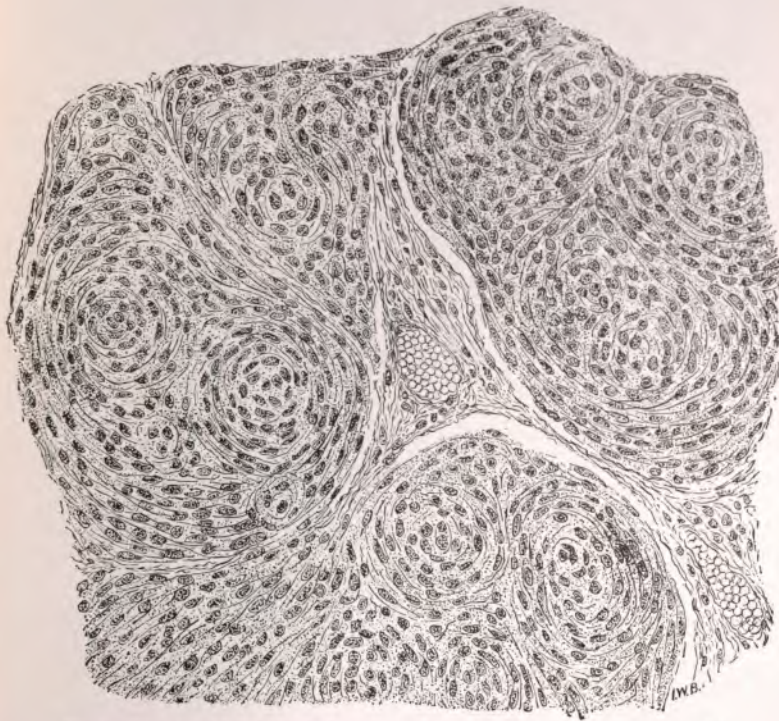


Fig. 4. Case 774. Spindle-celled sarcoma of dura mater.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





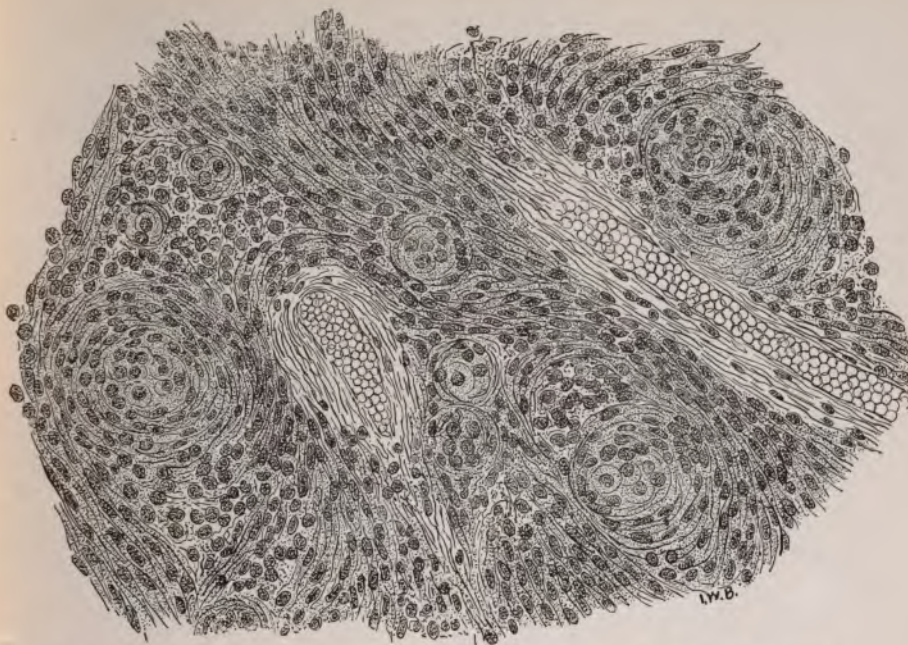


Fig. 5. Case 1436. Section from spindle-celled endothelial sarcoma of dura mater, showing the general structure of the growth, several concentrically arranged cell masses, and two blood vessels with fibrous walls running in longitudinally cut cell-groups. The fine stippling is used for shading; the cell bodies do not show granulation with this amplification.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

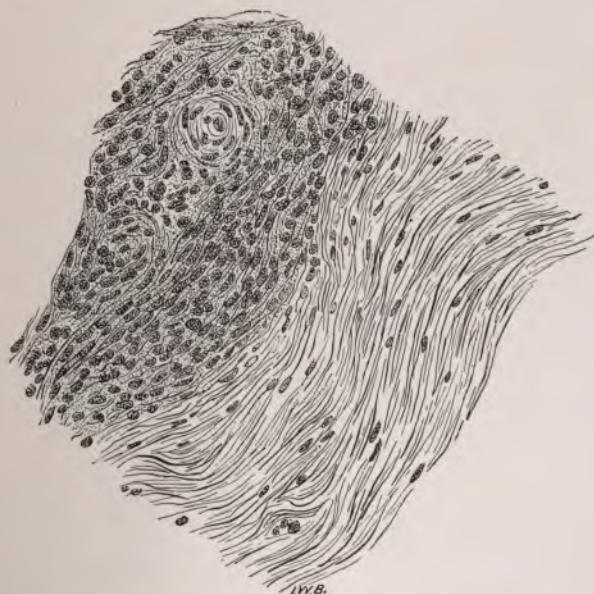


Fig. 6. Case 1436. Spindle-celled endothelial sarcoma of dura mater. Section from the junction of the growth with the inner layer of the membrane, showing the complete union of the two. At the surface of the dura the tumor was usually quite vascular.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)



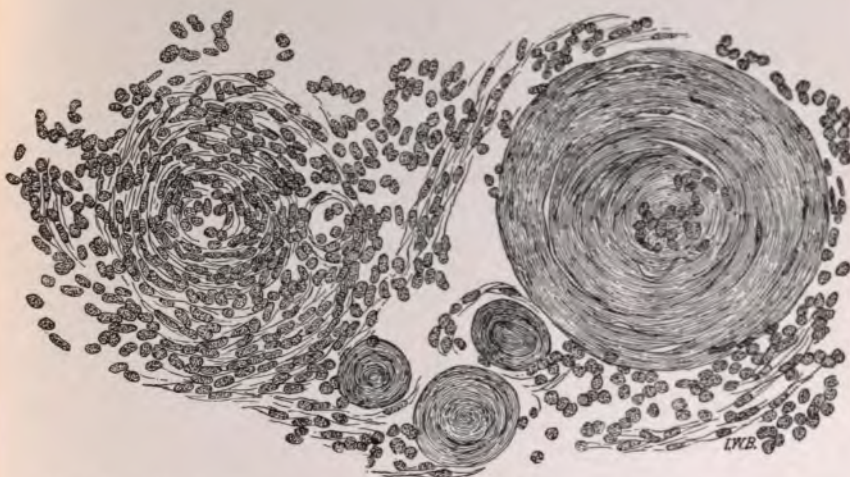


Fig. 7. Case 76. Tumor of brain, showing one large and three small hyaline bodies.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

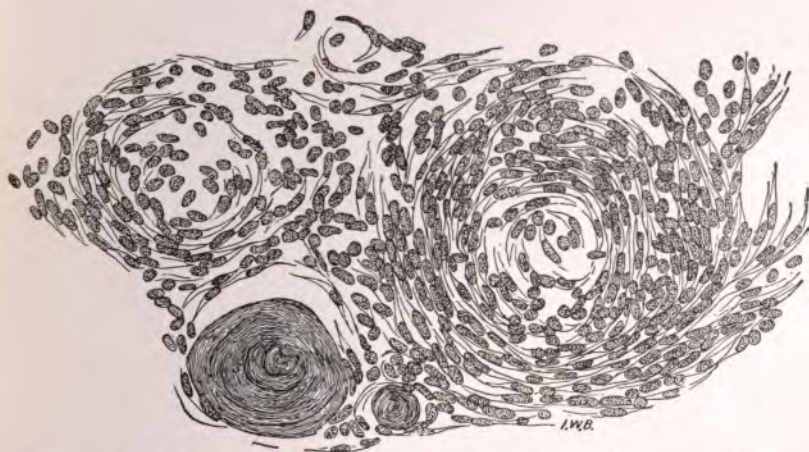


Fig. 8. Case 76. Tumor of brain, showing hyaline globes and cell nests.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





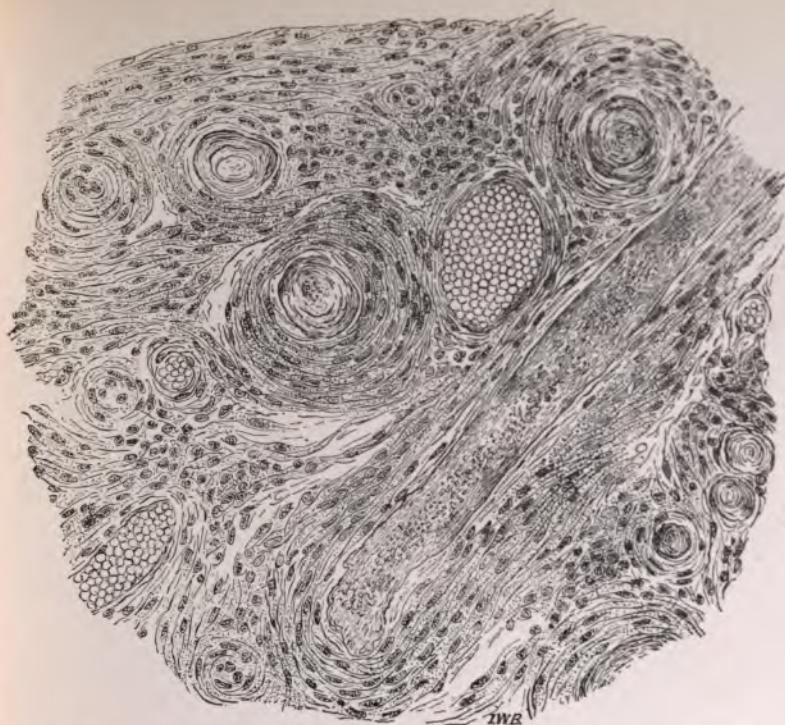


Fig. 9. Case 715. Spindle-celled sarcoma of the falx cerebri.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)

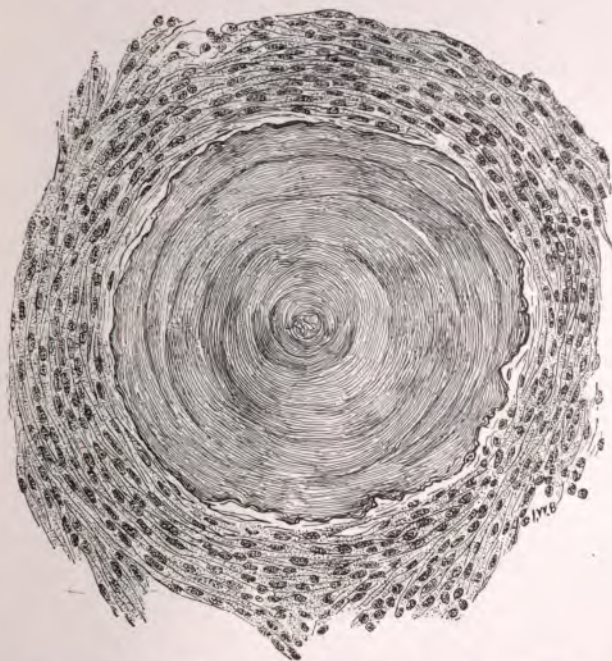


Fig. 10. Case 715. Large hyaline globe surrounded by many layers of spindle cells; from tumor of falx cerebri.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)







Fig. 11. Case 715. Tumor of the falx cerebri, enlarged  $\frac{1}{2}$ : (a) tumor; (b) dura mater; (c) superior longitudinal sinus; (d) falx cerebri, which may be traced for some distance through the tumor; (e) inferior longitudinal sinus; (f) Pacchionian body. The falx is bent over for convenience in sectioning.



I.V.B.

Fig. 12. Case 1146. Degenerated spindle-celled sarcoma of the dura mater. The cellular tissue has become fibrous and hyaline, so that the cells and nuclei are very indistinct, and many of the concentrically arranged cell masses have become fibrous, hyaline, and finally calcified. The almost homogeneous appearance of the degenerated tissue has been represented by fine stippling.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)



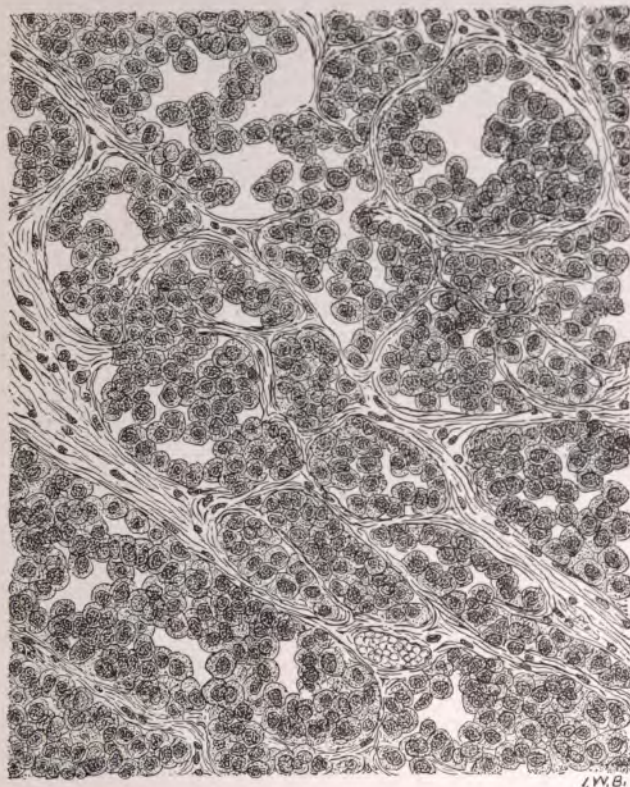


Fig. 13. Case 1146. Soft carcinoma of the pyloric end of the stomach. Some of the cells show tendency to columnar shape and a single layer arrangement along the walls of the alveoli.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

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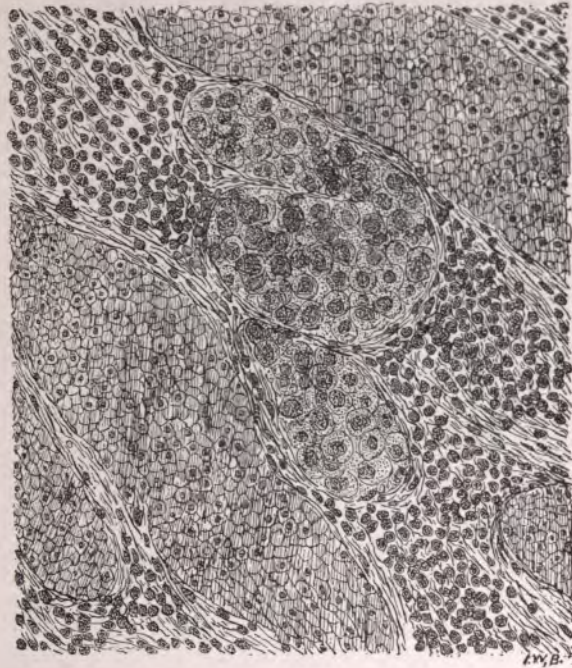


Fig. 14. Case 1146. Section showing cancer-cell nests in the connective tissue trabeculae between the muscular bundles of the middle layer of the stomach wall. The small cell infiltration of the connective tissue is seen in the vicinity of the cancerous nodules. The muscular bundles are cut transversely.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)







Fig. 15. Case 1516. Section of spindle-celled endothelial sarcoma of dura mater, showing several hyaline spherules still retaining the nuclei of cells, and hyaline bands in the midst of longitudinally cut spindle cells. One of the hyaline rods is cut transversely at one end, showing an oval outline.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)





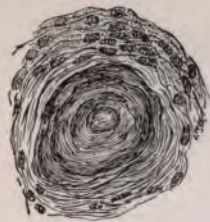


Fig. 16.

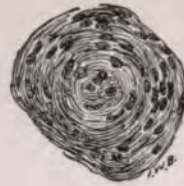


Fig. 17.

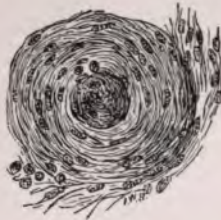


Fig. 18.

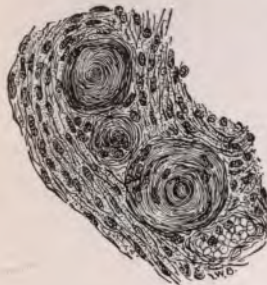


Fig. 19.

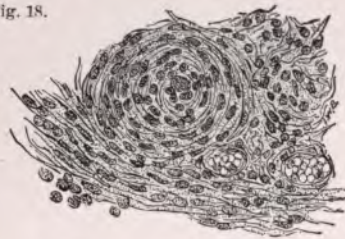


Fig. 20.

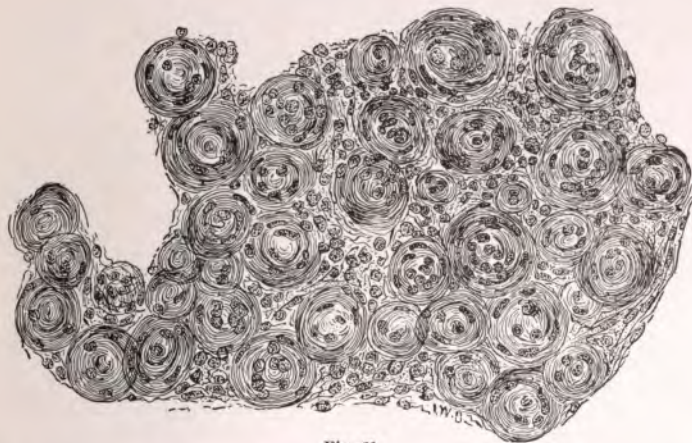


Fig. 21.

Figs. 16-20. Case 1516. Sections from spindle-celled endothelial sarcoma of dura mater, showing the various stages in the hyaline transformation of the cell spherules into hyaline globes. Fig. 21 shows the peculiar cell grouping which would develop into the so-called "psammoma" of some pathologists.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





Fig. 22. Case 965. Spindle-celled sarcoma of brain, with hyaline degeneration of the concentrically arranged cell-groups. Psammoma.  $\times 200$ . (Reduced  $\frac{1}{4}$ .)

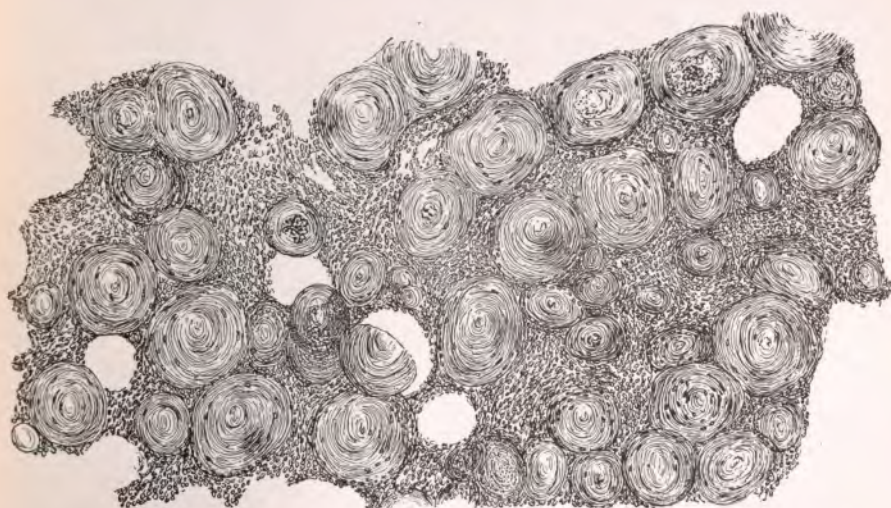


Fig. 23. Case 965. Low-power view of spindle-celled sarcoma, or psammosarcoma of brain, showing the numerous hyaline spherules which crowd the tissue.  $\times 50$ . (Reduced  $\frac{1}{4}$ .)







Fig. 24. Case 1503. Endothelial sarcoma of the dura mater. Section showing the general structure of the growth. Many cell whorls are shown separated by spindle-cell bands, and with endothelioid cells in the central portions. Numerous vessels with thick hyaline walls are shown, and a portion of a very large hyaline spherule.  $\times 200$ . (Reduced  $\frac{1}{2}$ .)

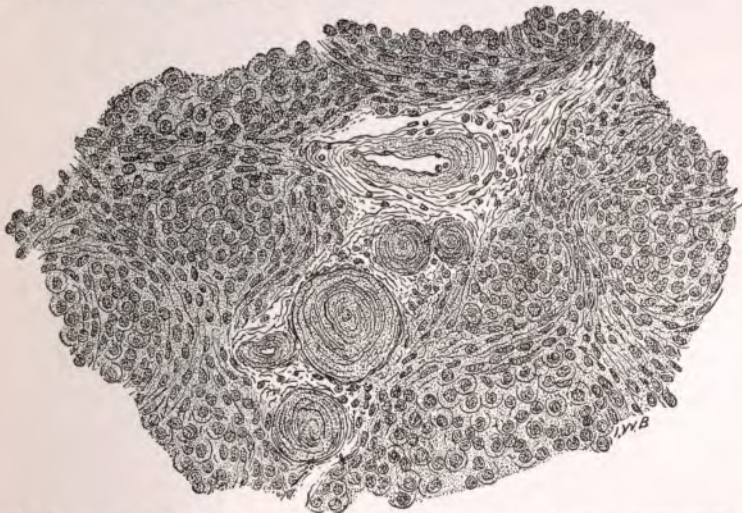


Fig. 25. Case 1503. Endothelial sarcoma of the dura mater. The drawing shows several cell groups separated by delicate bands of spindle-cell tissue, giving an alveolar appearance to the tissue. The central cells are seen to be round and endothelioid, the peripheral layers are spindle shaped, and in the cell bands the spindles are very delicate and the nuclei elongated. Four hyaline spherules and two thick-walled vessels are shown in the center of the drawing.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





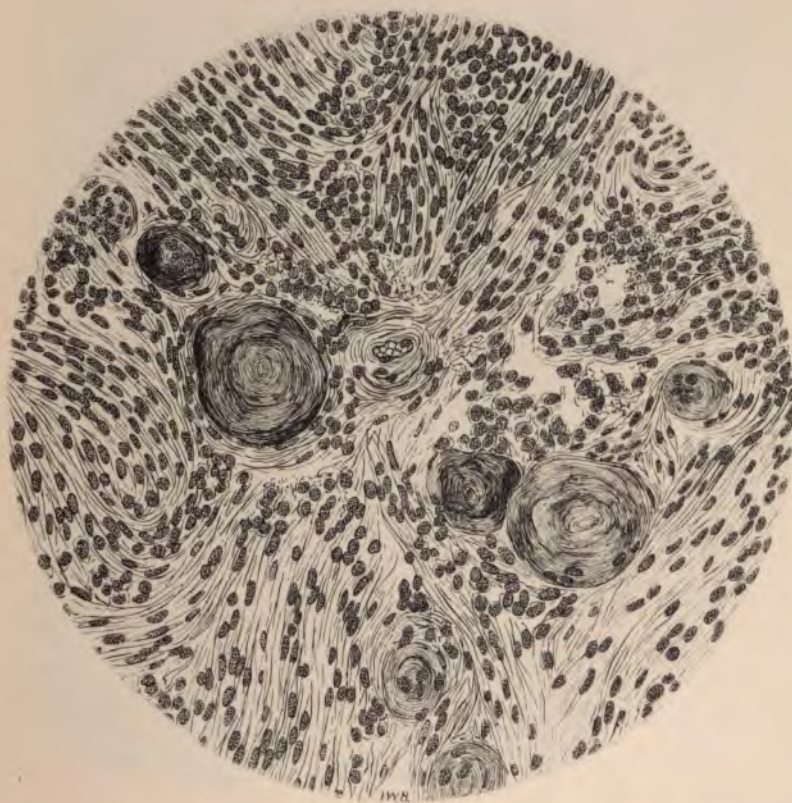


Fig. 26. Case 1582. Section showing the general structure of the spindle-celled endothelial sarcoma of dura mater. A number of hyaline spherules are seen and cell whorls in various stages of degeneration.

X 300. (Reduced  $\frac{1}{6}$ ).



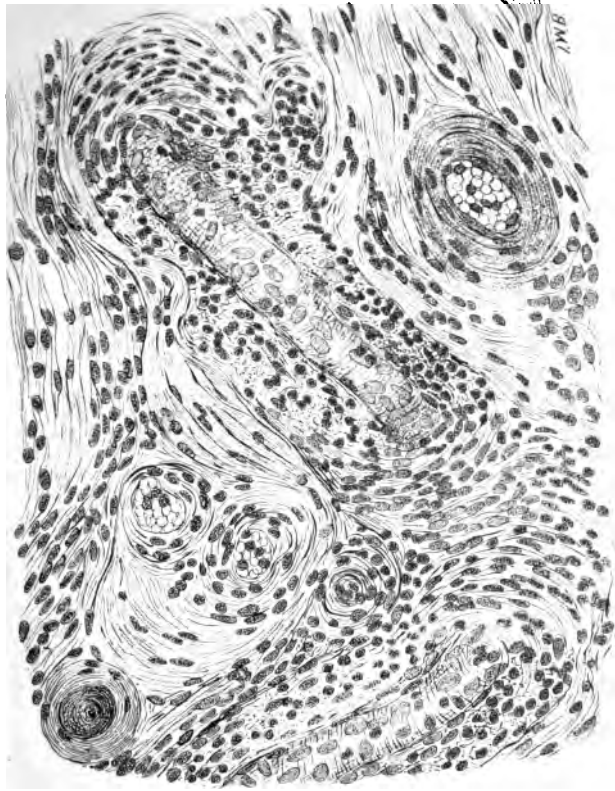


Fig. 27. Case 1582. Section from spindle-celled endothelial sarcoma of the dura mater showing a large curved blood vessel cut longitudinally; several transverse sections of vessels and a hyaline "pearl" in the upper left corner. The large vessel is seen to be coated with many layers of spindle-shaped cells and to have a distinct intima in which appear the large oval nuclei lying parallel with the length of the vessel, while the spindle-cell nuclei are transverse.

X 300. (Reduced  $\frac{1}{8}$ ).



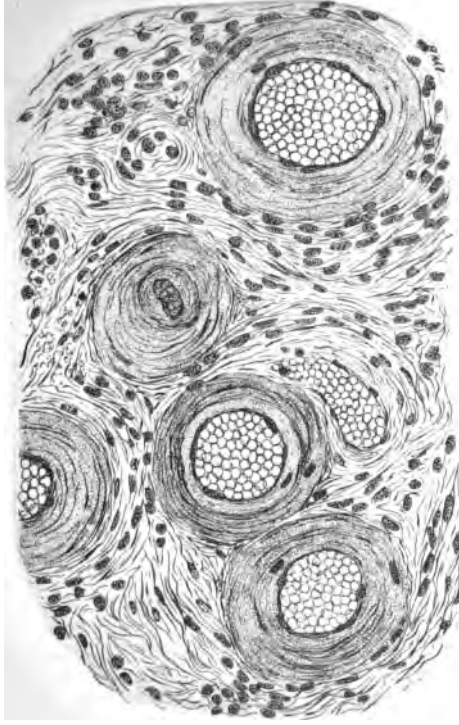


Fig. 28. Case 1582. Field from the spindle-celled endothelial sarcoma, showing several vessels with greatly thickened hyaline walls. Faint striation may be distinguished and an occasional nucleus. The endothelium is well preserved and the lumen is usually still pervious and filled with blood. The stroma consists of spindle-cells and fibrous tissue.

X 300. (Reduced  $\frac{1}{2}$ ).



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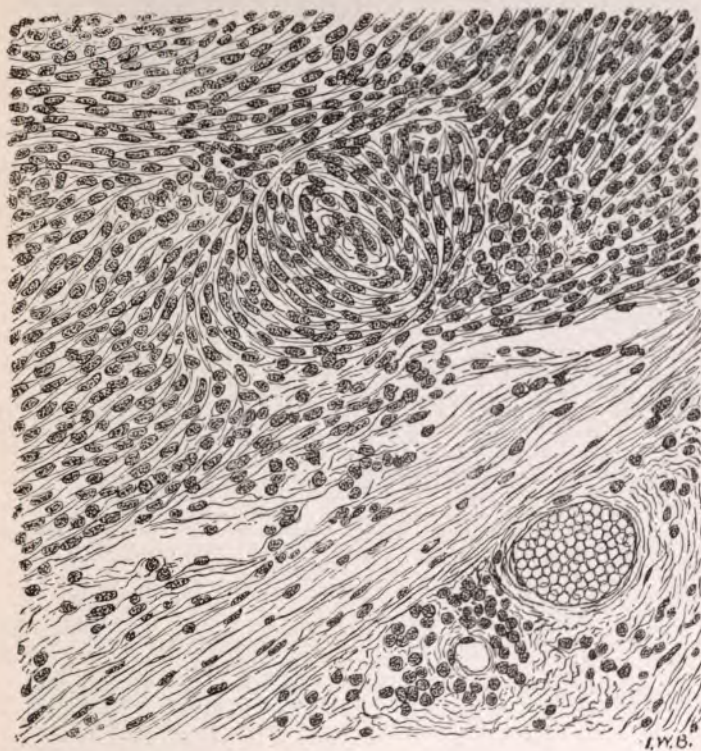


Fig. 29. Case 1178. Spindle-celled sarcoma of the dura mater. The section shows the general structure of the tumor and one of the bands of dense connective tissue which intersect the tumor in every direction. The whorl-like arrangement of the spindle cells is seen in the center of the drawing. The round nuclei are chiefly transverse sections of the spindle cells.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)



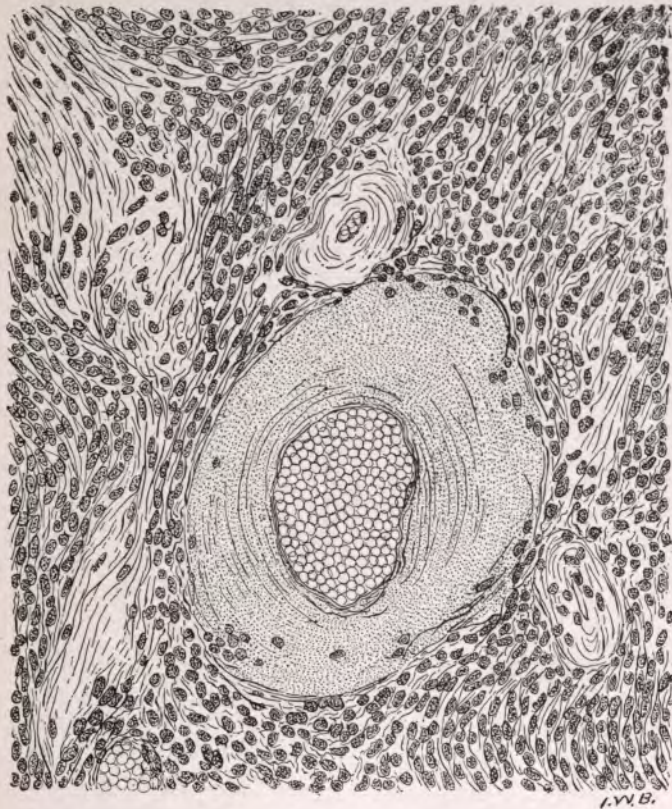


Fig. 30. Case 1178. Spindle-celled sarcoma of dura mater. The section shows a large blood vessel with an enormously thickened and hyaline wall, and two small vessels almost obliterated by the same process. Some dense connective tissue is seen in the vicinity of the blood vessels.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





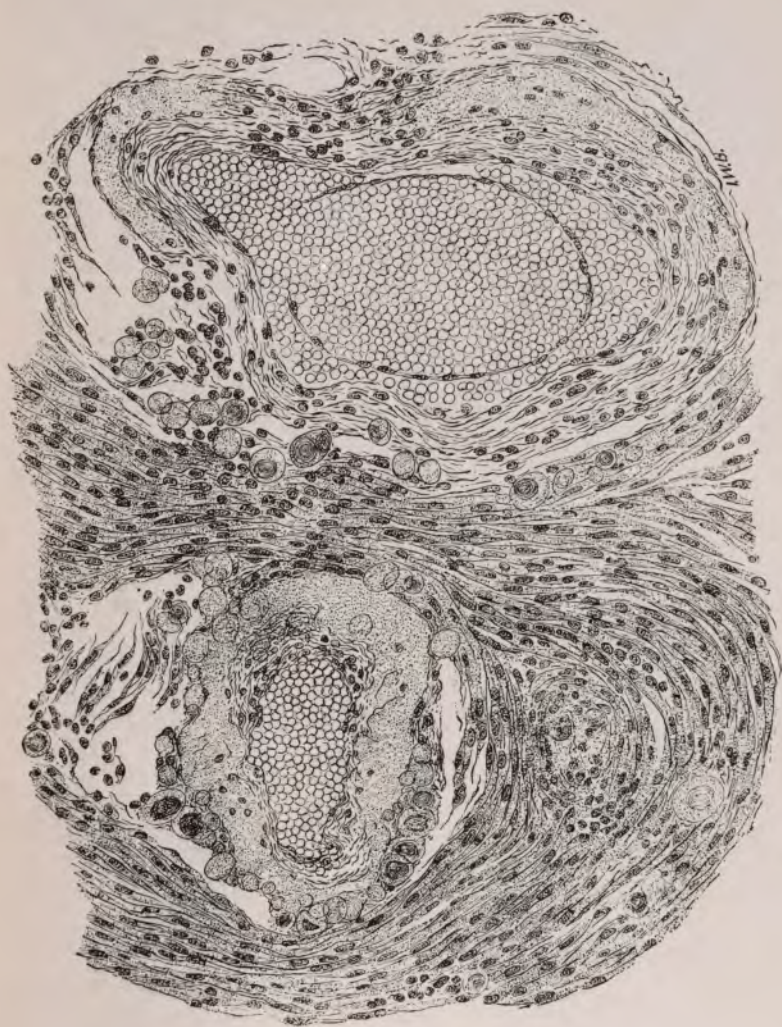


Fig. 31. Case 789. Spindle-celled sarcoma of dura mater.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





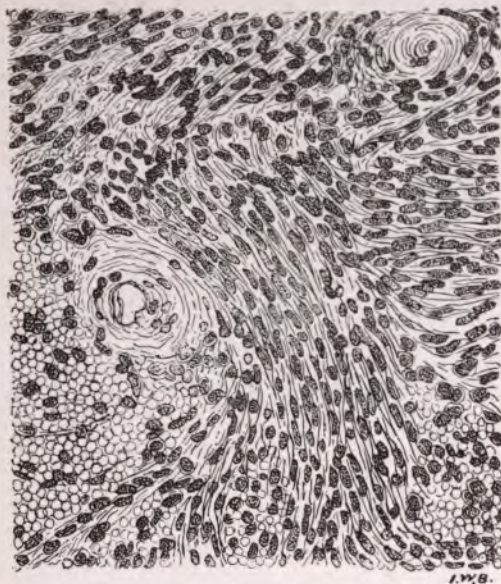


Fig. 32. Case 1130. Hemorrhagic spindle-celled sarcoma of cerebellum. The hemorrhagic infiltration is shown at the lower part of the drawing. A small artery with thickened hyaline walls, and one totally obliterated by the same process, are shown in the section.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)





Fig. 33. Case 1130. Soft fibroma of the skin. The field shows a transverse section of a small artery and an optical longitudinal section of a minute vein.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

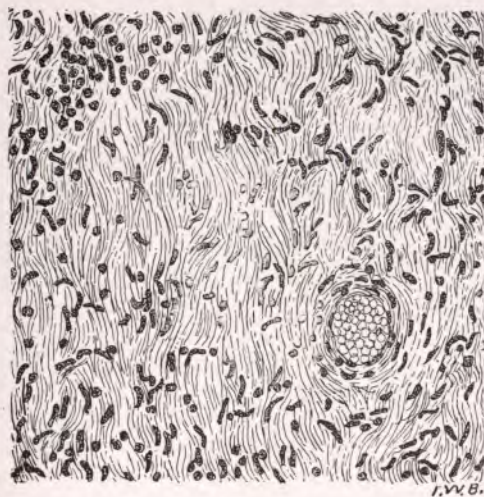


Fig. 34. Case 1130. Soft fibroma of the skin. This section was taken from the firmer and older portion of one of the tumors where the fibrous tissue was better developed and the cells smaller and less numerous than in fig. 33.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





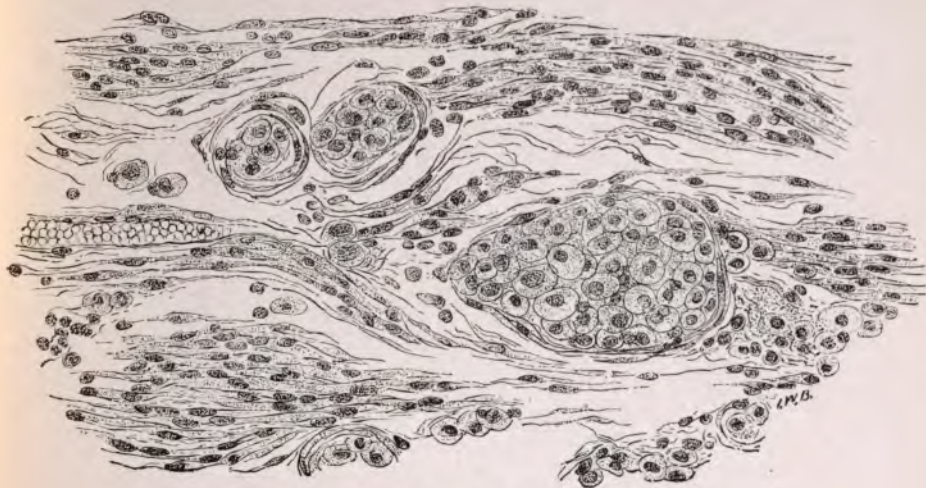


Fig. 35. Case 833. Endothelial sarcoma of dura mater.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

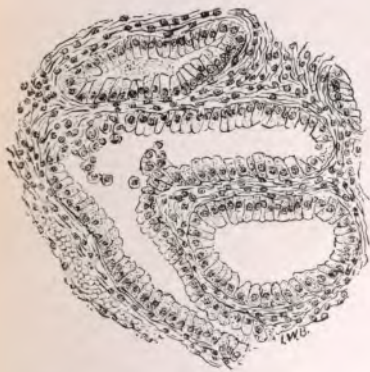


Fig. 36. Case 833. Adenoid cancer of stomach.  $\times 200$ . (Reduced  $\frac{1}{2}$ .)

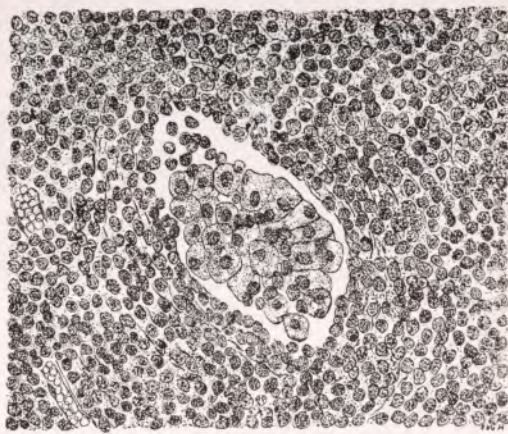


Fig. 37. Case 833. Small round-celled sarcoma of testicle.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





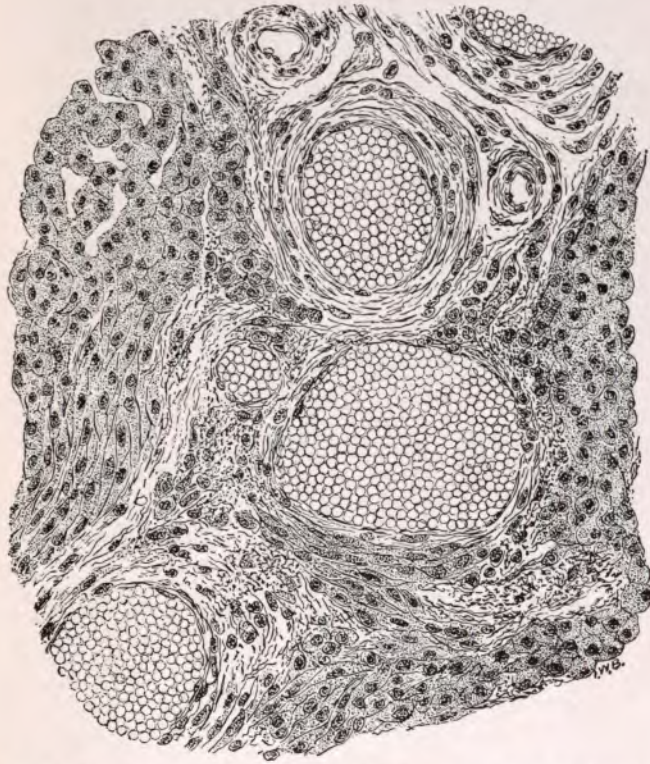


Fig. 38. Case 539. Endothelial sarcoma of dura mater.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)





**Fig. 39.** Case 27S. Endothelial spindle-celled sarcoma of the dura mater. Field showing the general structure of the cellular portions. The oval nuclei belong to spindle cells with narrow cell-bodies closely applied to each other; the round nuclei probably are transverse sections of the same cells, though round cells apparently exist in groups in some parts of the growth.

X 300. (Reduced  $\frac{1}{8}$ ).



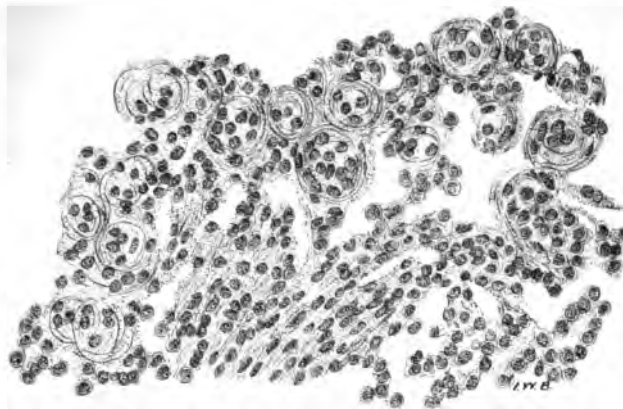


Fig. 40. Case 278. Section of the same tumor represented in Fig. 39, showing the tendency of some of the cells to arrange themselves in concentric groups. Some spindle-cell tissue is shown in bands, and some round cells without clearly defined cell bodies at the lower part of the field. The cells are closely grouped in the denser portions of the tissue and it seems almost impossible to isolate individual elements, on this account the faintly granular intercellular substance is not distinguishable from the cell bodies in these drawings.

X 300. (Reduced  $\frac{1}{2}$ ).





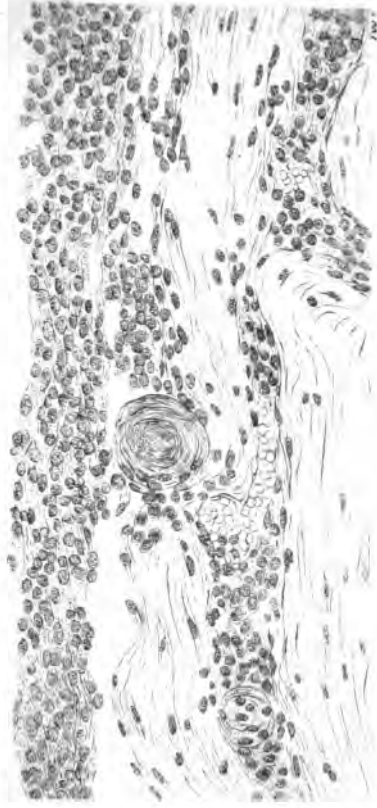


Fig. 41. Case 278. Section from the tumor represented by Figs. 39 and 40, showing the line of junction between the dura mater and the tumor tissue. A space, probably a lymph channel, in the dura is shown to contain tumor cells already developing into spindle shapes and forming a concentrically arranged cell spherule at the left. A hyaline globe is seen in the central part at the edge of the dura. The attachments to the membrane are mainly cellular and easily detached, as seen at the left.

X 300. (Reduced  $\frac{1}{6}$ ).





Fig. 42. Case 601. Glioma of brain, showing the various shapes of the cells.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

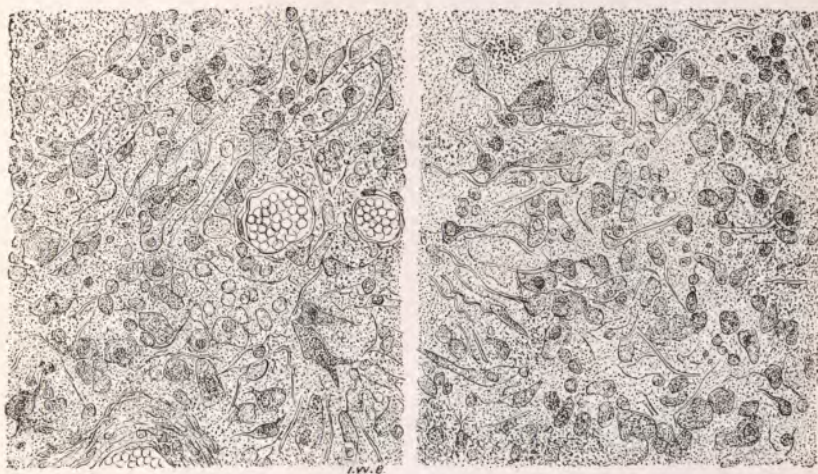


Fig. 43. Case 832. Glioma of brain.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





Fig. 44. Case 1053. Section of glioma of brain, showing the general structure, the various shapes of the cells, and a small blood vessel with thick fibrous walls.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

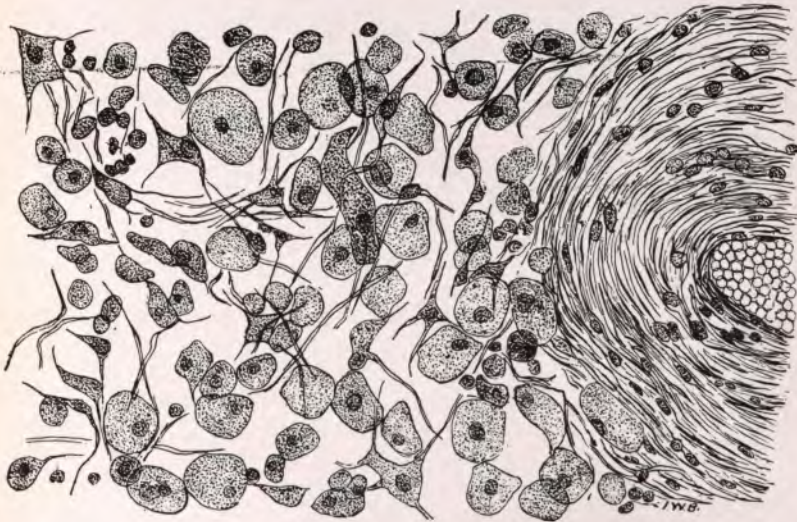


Fig. 45. Case 1053. Section from the looser portion of the tumor, showing the cells swollen and rounded when uninfluenced by pressure; and also a portion of the wall of a greatly thickened blood vessel.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





**Fig. 46.** Case 1053. Section of glioma of brain showing peculiar grouping of the cells around the walls of a blood vessel. Long spindle-shaped cells, and astrocytes send processes toward the borders of the perivascular space, somewhat like the glia cells in gliosis.

X 300. (Reduced  $\frac{1}{4}$ ).







Fig. 47. Case 1426. Section of glioma, showing the various shapes and sizes of the glomatous cells, and two large blood vessels with thick fibrous walls, surrounded by many nuclei. In some parts of the section large, clear, round cells are numerous.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





Fig. 48. Case 1426. Section of glioma of brain, including several cancer-like alveoli. On the left is the true gliomatous structure; on the right are several cancer-like alveoli. Between the two the tissue is more condensed and fibrous, but still shows its gliomatous nature. The epitheloid cells of the alveoli stain deeply in hematoxylin and are slightly granular.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)



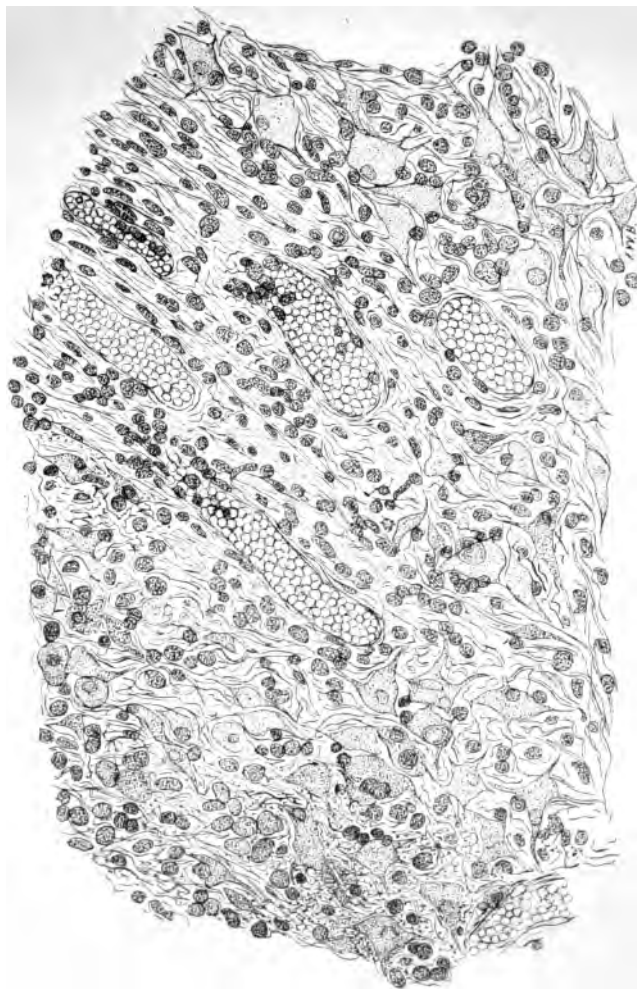
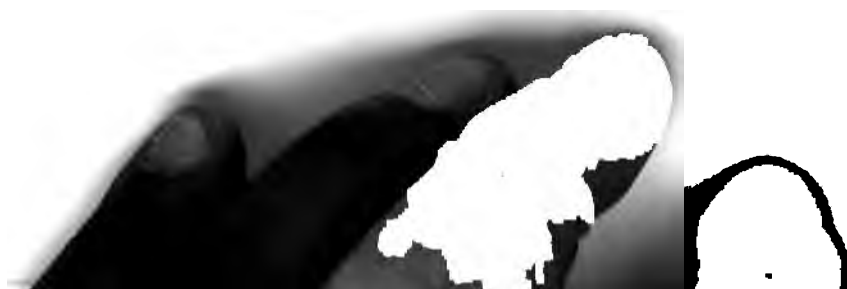
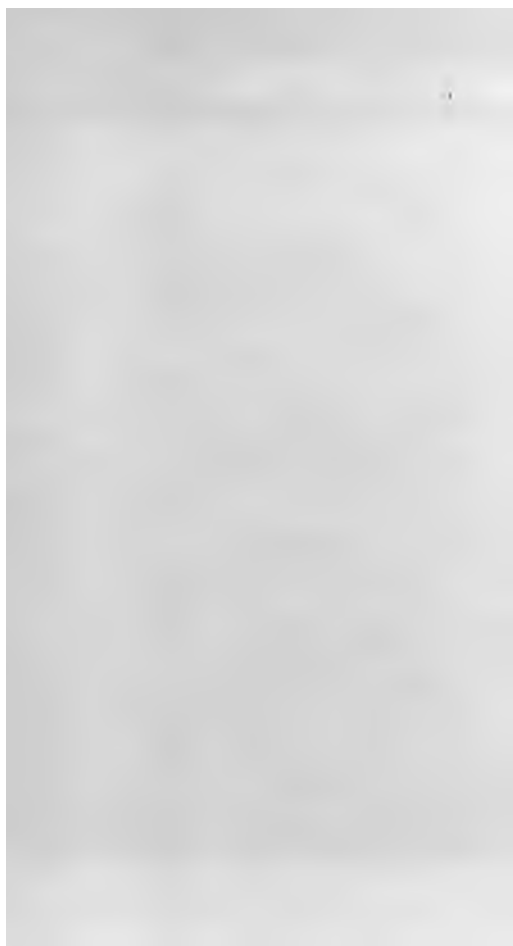


Fig. 49. Case 1619. Glioma of brain. The section shows the general structure of the tumor in the most characteristic situations. The large astrocyte elements stain faintly in the usual nuclear stains and often appear without visible nuclei, and almost homogeneous cell bodies. The fine stippling is used for shading, as the cells are not granular under low amplification. X 300. (Reduced  $\frac{1}{4}$ ).





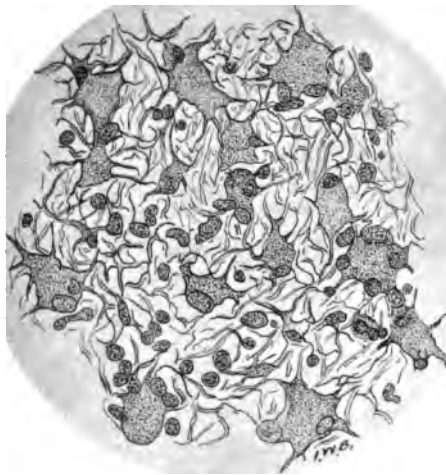
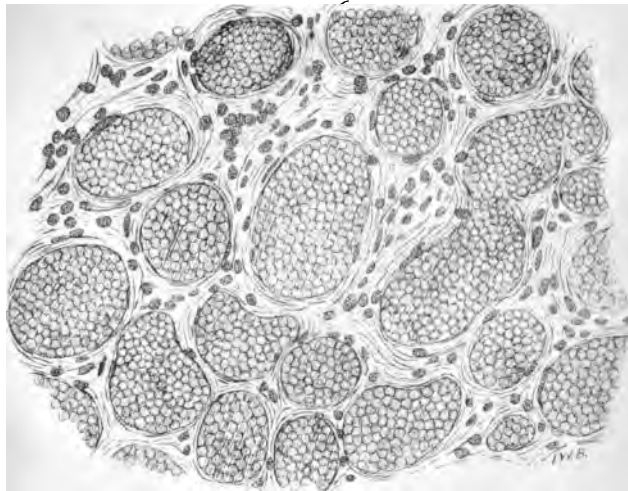


Fig. 50. Case 1619. Small field from glioma, showing typical astrocytes. In ordinary sections the fibres cannot be traced to any great distance from the cell bodies. The intercellular fibrillae are probably mainly branches of cells; the nuclei present no visible protoplasmic substance but may also be of glial origin.

X 300. (Reduced  $\frac{1}{6}$ ).

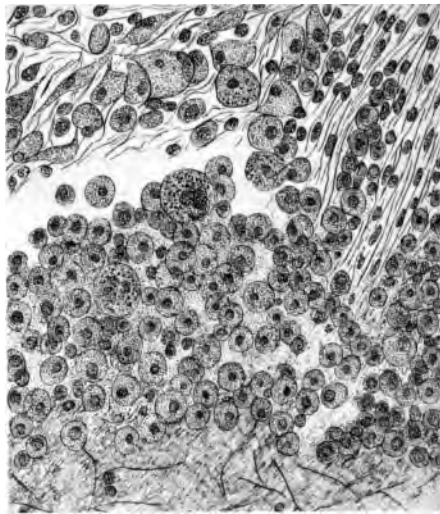




**Fig. 51.** Case 1619. Field from the most vascular portion of the glioma of brain represented in Figs. 49 and 50. The structure consists mainly of large blood-channels, or dilated capillaries with a stroma of finely striated and nucleated connective tissue. Some of the nuclei are elongated and probably belong to spindle-cells, but no glia elements can be found in these situations.

**X 300.** (Reduced  $\frac{1}{6}$ ).





**Fig 52.** Case 1619. Small field from glioma, showing the tissue bordering on a small cyst-like cavity filled with the products of degeneration. The large round cells resemble those found in the vicinity of cerebral softenings, and are probably altered neuroglia elements from their resemblance to those seen at the edge of the tumor tissue shown above.

X 300. (Reduced  $\frac{1}{8}$ ).





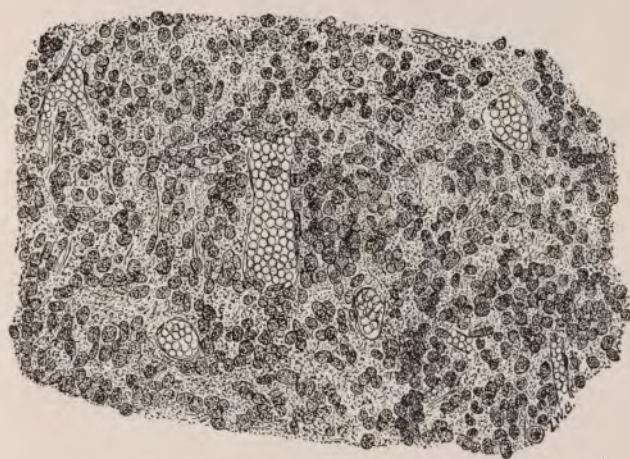


Fig. 53. Case 820. Glio-sarcoma of brain.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)



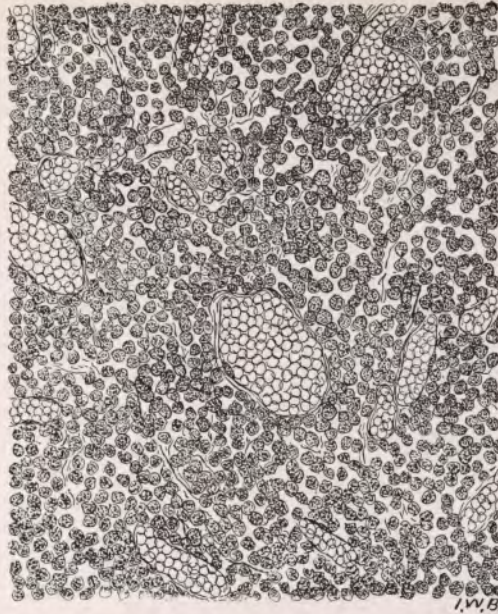


Fig. 54. Case 1237. Small round-celled sarcoma of brain. Numerous sections of blood vessels with walls composed of a single layer of endothelium, or flattened sarcomatous cells, are seen in the field.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

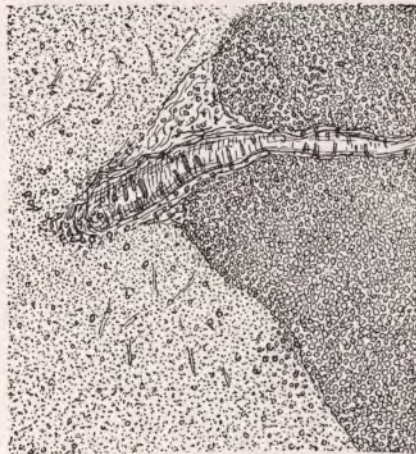


Fig. 55. Case 1237. Low-power view of the advancing border of round-celled sarcoma, as it encroaches upon the white matter of the hippocampus major. The growth seems to follow the adventitia of a small artery which extends to some distance into the tumor tissue.  $\times 50$ .



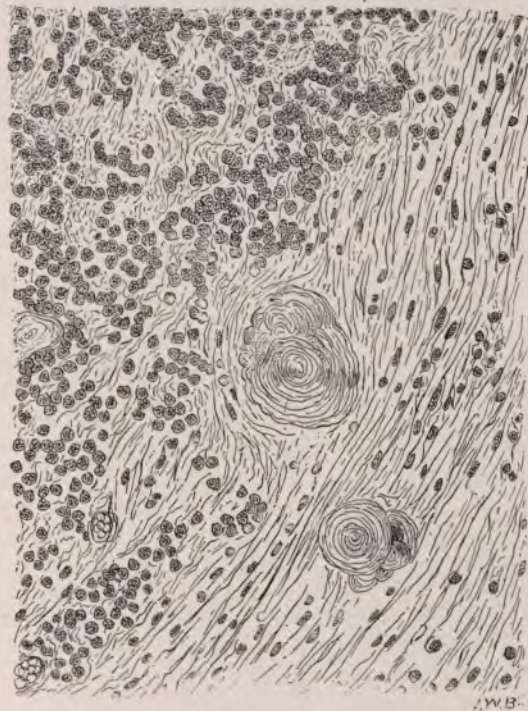


Fig. 56. Case 1237. Advancing border of round-celled sarcoma of brain. Showing large band of connective tissue, probably derived from the pia mater. Two concentrically striated calcareous bodies are seen near the edge of the tumor tissue.  $\times 300$ . (Reduced  $\frac{1}{4}$ .)





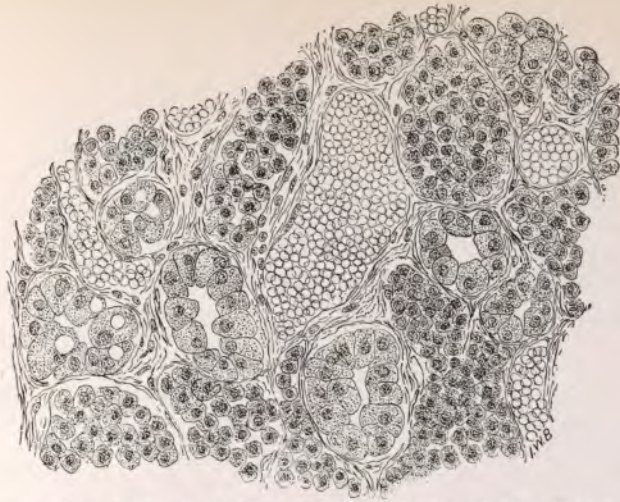


Fig. 57. Section of normal pituitary body, to compare with the adenoma in Case 788.  $\times 300$ .  
(Reduced  $\frac{1}{2}$ .)

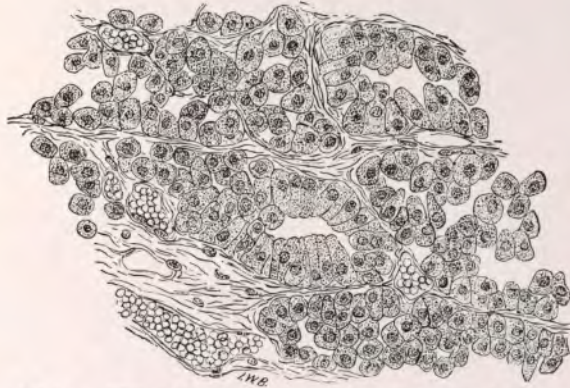


Fig. 58. Section of normal pituitary body.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

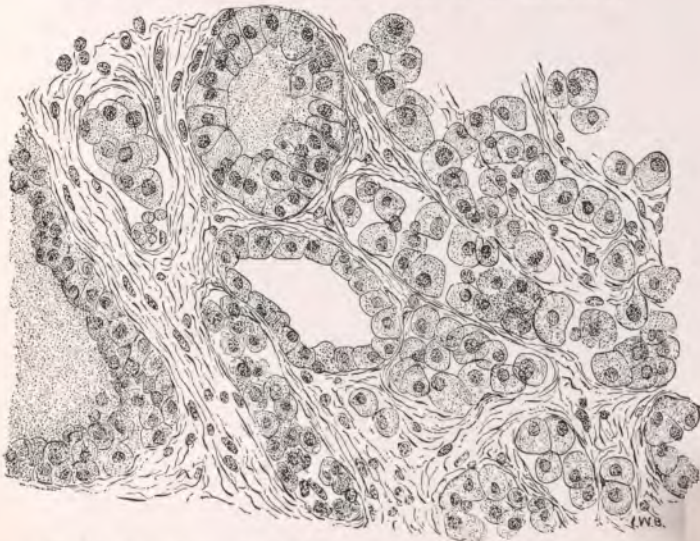
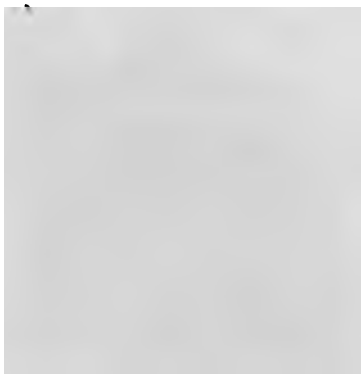


Fig. 59. Section from normal adult pituitary body.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)



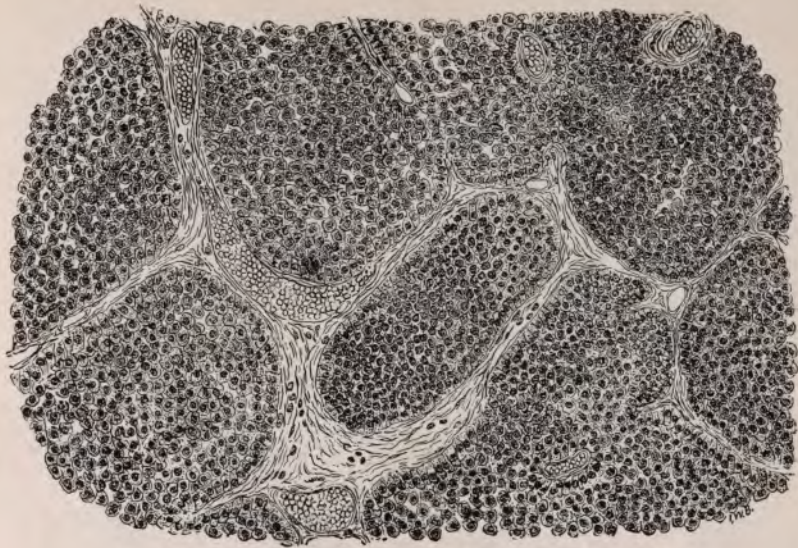


Fig. 60. Case 788. Adenoma of pituitary body.  $\times 200$ . (Reduced  $\frac{1}{2}$ .)



Fig. 61. Case 788. Adenoma of pituitary body.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)





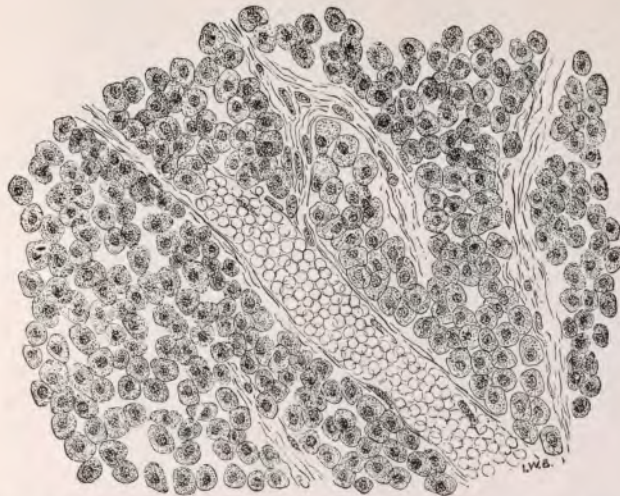


Fig. 62. Case 788. Section from adenoma of pituitary body,  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

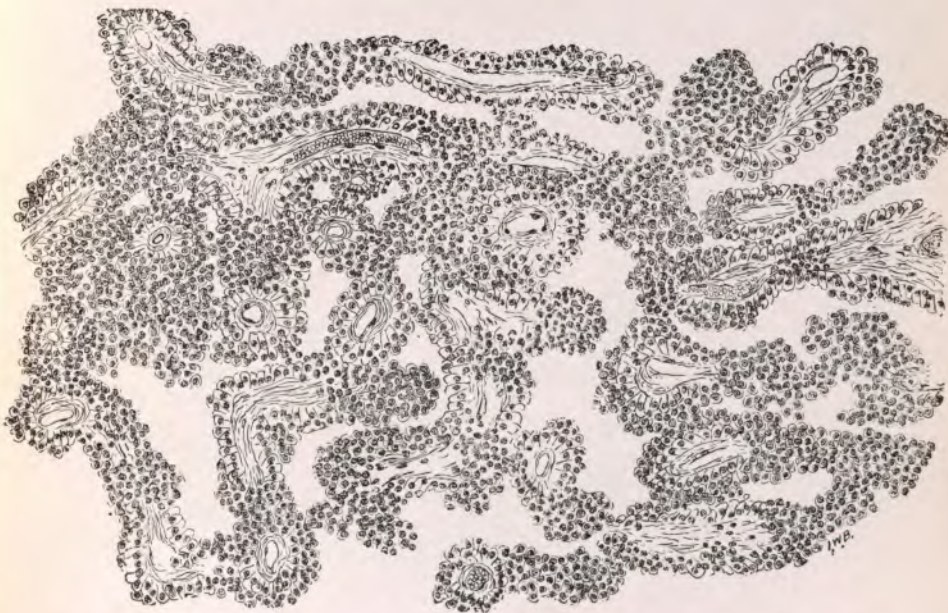


Fig. 63. Case 788. Section from looser portion of the pituitary adenoma.  $\times 200$ . (Reduced  $\frac{1}{2}$ .)





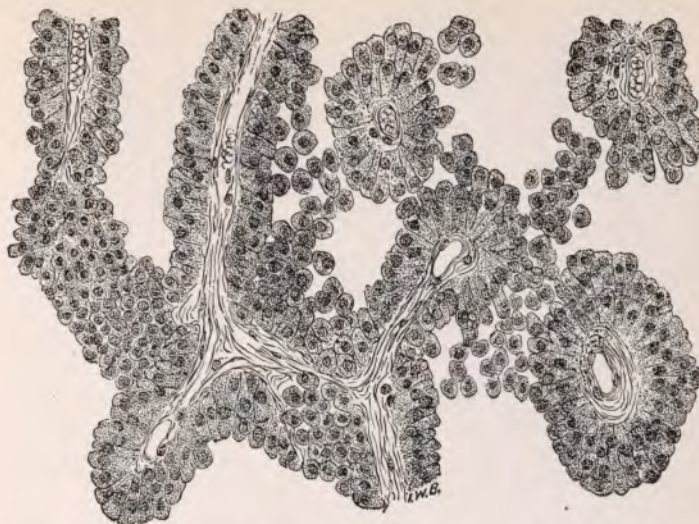


Fig. 64. Case 788. Papillary growth in pituitary adenoma.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

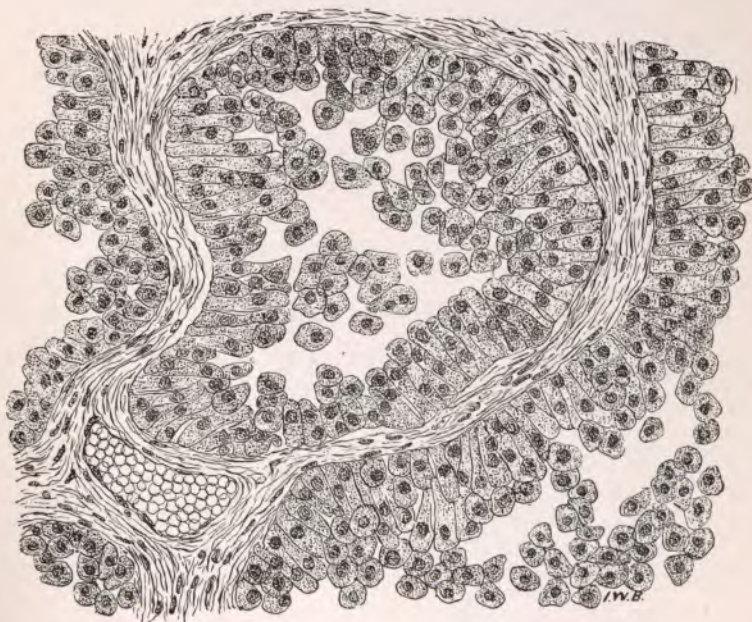


Fig. 65. Case 870. Adenoma of the pituitary body.  $\times 300$ . (Reduced  $\frac{1}{2}$ .)

100

100

## DESCRIPTION OF PLATES.

- PLATE I (*Case 858*).—Section through the tumor near its middle, showing its relation to the calcarine fissure and the median surface of the occipital lobe; and the encroachment upon the posterior horn of the ventricle. The section was made after hardening the brain; the definition between the brain tissue and that of the tumor is therefore not so distinct as in the fresh condition.
- PLATE II (*Case 842*).—View of the tumor of the frontal lobes seen from the base. The relative size and the position are well shown.
- PLATE III (*Case 842*).—Median section of the brain showing half the tumor *in situ*. The displacement of the brain structures is well shown. The small portion of falx which was adherent to the tumor is seen in position.
- PLATE IV (*Case 774*).—This plate represents the median section of the brain, and shows the tumor in the frontal lobes and the displacement of the brain structures by it. A small portion of the falx was left *in situ* to show its adhesions to the tumor. To prevent glistening of the surface the photographs of fresh specimens were taken under water by the use of a mirror. The pictures of such are, therefore, marked "reversed." It will be observed that this tumor is in the same situation, and it has almost the same structure, as that shown in Pl. III. The situation seems to be rather a common one for tumors of this kind, but for what reason is not clear.
- PLATE V (*Case 1146*).—Soft carcinoma of the pyloric end of the stomach. The pylorus was laid open by a section running parallel with the long axis of the stomach. The darker portions of the tumor were ulcerated and hemorrhagic. The picture shows portions of stomach and duodenum; the walls of the former somewhat thickened. A tumor of the dura mater which coexisted in this case was not photographed. See figs. 12, 13, and 14.

## ERRATA.

### DESCRIPTION OF PLATES. PAGE 7.

For plate VI read plate VIII

“	“	VII	“	“	X
“	“	VIII	“	“	XI
“	“	IX	“	“	XII
“	“	X	“	“	XIII
“	“	XI	“	“	XIV
“	“	XII	“	“	VI
“	“	XIII	“	“	VII
“	“	XIV	“	“	IX

- PLATE X (*Case 1130*).—Superior view of cerebellum and tumor. The photograph shows the tumor in place, the increased bulk of the left hemisphere of the cerebellum from the presence of the tumor, the fifth nerve stretched over the growth, and the lateral displacement of the pons.
- PLATE XI (*Case 1130*).—The plate shows the larger soft fibromata of the skin, though hundreds of minute nodules are invisible owing to the small size of the photograph. The tumors were especially numerous on the forehead and arms. The coexistence of multiple soft fibromata of the skin with tumor of the cerebellum was deemed of sufficient interest to introduce this plate, though there was evidently no aetiological relationship between the growths.
- PLATE XII (*Case 965*).—View of the base of the brain, showing the tumor in the portion of the temporal lobe. The flat portion of the tumor, which rested tentorium, is shown, and also the displacement of the occipito-temporal relations, and the proximity of the growth to the crus and pons. The photo is reversed.



## DESCRIPTION OF PLATES.

PLATE I (*Case 853*).—Section through the tumor near its middle, showing its relation to the calcarine fissure and the median surface of the occipital lobe; and the encroachment upon the posterior horn of the ventricle. The section was made after hardening the brain; the definition between the brain tissue and that of the tumor is therefore not so distinct as in the fresh condition.

PLATE II (*Case 842*).—View of the tumor of the frontal lobes seen from the base. The relative size and the position are well shown.

PLATE III (*Case 842*).—Median section of the brain showing half the tumor *in situ*. The displacement of the brain structures is well shown. The small portion of falx which was adherent to the tumor is seen in position.

PLATE IV (*Case 774*).—This plate represents the median section of the brain, and shows the tumor in the frontal lobes and the displacement of the brain structures by it. A small portion of the falx was left *in situ* to show its adhesions to the tumor. To prevent glistening of the surface the photographs of fresh specimens were taken under water by the use of a mirror. The pictures of such are, therefore, marked "reversed." It will be observed that this tumor is in the same situation, and it has almost the same structure, as that shown in Pl. III. The situation seems to be rather a common one for tumors of this kind, but for what reason is not clear.

PLATE V (*Case 1146*).—Soft carcinoma of the pyloric end of the stomach. The pylorus was laid open by a section running parallel with the long axis of the stomach. The darker portions of the tumor were ulcerated and hemorrhagic. The picture shows portions of stomach and duodenum; the walls of the former somewhat thickened. A tumor of the dura mater which coexisted in this case was not photographed. See figs. 12, 13, and 14.

PLATE VI (*Case 1503*).—Spindle-celled endothelial sarcoma of the dura mater, penetrating the brain at the anterior portion of the right frontal lobe. A small portion of the dura is left adherent to indicate the origin of the growth. The third frontal convolution is seen to be pushed upward and backward.

PLATE VII (*Case 1178*).—This plate shows a section made exactly through the center of the spindle-celled sarcoma of the dura mater. A section of the skull was also made and placed in position to be photographed. The elevation of the inner surface of the bone at the point of origin of the tumor is thus seen *in situ*. The section shown includes the dura over the convexity which was adherent to the tumor, the falx, and tentorium. The photograph shows the lines of connective tissue which radiate from the place of origin of the tumor and intersect it in every direction. The growth of the tumor from the dura, its evident encroachment upon the brain, and the well-defined boundaries of the growth are clearly shown.

PLATE VIII (*Case 1178*).—The outline diagram shows the situation of the tumor, its encroachment on the cortical motor areas, and the line of section shown by Pl. VII.

PLATE IX (*Case 1130*).—Hemorrhagic spindle-celled sarcoma of cerebellum. The plate shows the inferior view of the cerebellum with the tumor *in situ*. The relative size of the growth the depression made in the cerebellum and the displacement of the pons are well shown.

PLATE X (*Case 1130*).—Superior view of cerebellum and tumor. The photograph shows the tumor in place, the increased bulk of the left hemisphere of the cerebellum from the presence of the tumor, the fifth nerve stretched over the growth, and the lateral displacement of the pons.

PLATE XI (*Case 1130*).—The plate shows the larger soft fibromata of the skin, though hundreds of minute nodules are invisible owing to the small size of the photograph. The tumors were especially numerous on the forehead and arms. The coexistence of multiple soft fibromata of the skin with tumor of the cerebellum was deemed of sufficient interest to introduce this plate, though there was evidently no etiological relationship between the growths.

PLATE XII (*Case 965*).—View of the base of the brain, showing the tumor in the basal portion of the temporal lobe. The flat portion of the tumor, which rested on the tentorium, is shown, and also the displacement of the occipito-temporal convolutions, and the proximity of the growth to the crus and pons. The photograph is reversed.

- PLATE XIII (*Case 965*).—This section of the brain shows the depth to which the tumor had penetrated and the displacement of the convolutions by it. The section passed exactly through the middle of the growth.
- PLATE XIV (*Case 1582*).—Spindle-celled endothelial sarcoma of the dura mater penetrating the lower portion of the temporal lobe. The growth is seen in profile and therefore appears smaller than the actual size.
- PLATE XV (*Case 1053*).—Median section of the brain, showing the glioma of the corpus callosum and frontal lobes. The degeneration and hemorrhage in the central portions of the growth are clearly shown, and the swollen convolutions in the vicinity with the cerebral arteries embedded in them.
- PLATE XVI (*Case 1426*).—Section through the middle of a glioma of the left frontal lobe. It may be seen by the dotted line which marks the apparent limits of the growth, that the tumor tissue did not reach the surface membranes and that it extended to the roof of the lateral ventricle. The small cystic cavity shown at (a) is one of those not uncommon in gliomata.
- PLATE XVII (*Case 1619*).—Horizontal section of the brain showing a large hemorrhagic glioma occupying the left frontal lobe. The increased size of the lobe, the encroachment upon the insula, and the pressure upon the basal ganglia and the internal capsule are well shown in the picture. The tumor evidently originated in the white matter, did not extend to the membranes, and the outer portion of the cortex was unaffected. Several small softened areas are seen in the basal ganglia the result of disease of the cerebral arteries.
- PLATE XVIII (*Case 1619*).—Upper half of the brain showing the glioma *in situ*. The increase in the size of the lobe and the pressure upon the central structures are well shown in this section. The tumor tissue with the alternating degenerated and hemorrhagic areas presents a mottled appearance which clearly defines the limits of the growth.
- PLATE XIX (*Case 820*).—This plate represents the external appearance of the glioma of the brain found in this case. The color of the affected region gave it a dark shade in the photograph, and the alteration of shape of the affected temporal lobe is well shown. A portion corresponding to the uncinate gyrus is much enlarged and has pressed aside the optic nerves and the crus.
- PLATE XX (*Case 1237*).—Round-celled sarcoma of the brain; shown by section through the corpus callosum, median line of cerebellum, and into the posterior cornua of the lateral ventricles. The fungoid masses which grew into the ventricles are well shown. To distinguish the tumor masses from the brain substance fine stippling has been used.
- PLATE XXI (*Case 1237*).—This plate shows a view of the same tumor after removal of the superior portions of the hemispheres on a level with the basal ganglia. The plate shows more clearly the fungoid tumor masses, the great enlargement of the lateral ventricles owing to obstruction of the aqueduct of Sylvius by the growth of the tumor, and the extensive invasion of the cerebellum. The apparent asymmetry of the two hemispheres is due to distortion during hardening after sections had been made.
- PLATE XXII (*Case 788*).—In this plate the adenoma of the pituitary body is shown *in situ*. The displaced nerves and arteries are seen around the tumor. The rough surface is the portion which was removed from the pituitary fossa.
- PLATE XXIII (*Case 788*).—This plate shows the depression made by the pituitary tumor in the base of the brain. The structures which were displaced and pressed upon may all be seen.
- PLATE XXIV (*Case 870*).—This plate shows the base of the brain with the pituitary tumor *in situ*. The relative size of the growth is well shown, and the extreme separation of the arteries of the circle of Willis, the olfactory nerves, optic nerves, and the basal portions of the temporal lobes. The optic nerves lie apparently turned backward over the tumor, and the chiasma may be seen stretched between them. The third nerves may be seen between the pons and the tumor. The darker portion of the tumor is that which was dissected from the pituitary fossa.
- PLATE XXV (*Case 870*).—This plate represents the median surface of the brain and the pituitary tumor, photographed after hardening. The specimen was somewhat flattened by lying on the convexity and the pia mater was wrinkled by shrinkage of the brain tissue. The size of the growth and its encroachment upon the ventricular cavity are well shown. The cut surface of the tumor presents a more granular appearance than in the fresh condition. A slight constriction marks off the portion which lay in the enlarged pituitary fossa. The parts within the ventricular cavity immediately adjoining the tumor being extremely soft at the autopsy did not harden well and are therefore not well defined in

PLATE XXVI (*Case 991*).—Section of cerebellum, showing tubercular tumor.

PLATE XXVII (*Case 805*).—Aneurism of the right middle cerebral artery. The displacement of the middle cerebral artery, the optic nerves, the third nerve, and the adjoining portion of the temporal lobe is well shown. The adherent tentorium and a small calcareous nodule are seen on the surface of the tumor.

PLATE XXVIII (*Case 805*).—View of a dissection showing a quarter section of the aneurismal sac left *in situ*. The opening which existed in the artery still communicated with the aneurismal sac, though the cavity was about filled up with a dry, friable mass of altered blood clot. The opening is easily seen and the posterior communicating artery is distinguished by a bristle passed through it.

PLATE XXIX (*Case 1246*).—Photograph of the interior of a scaphoid calvaria, showing hyperostoses of the inner table of the frontal bone and small nodular exostoses along the line of the obliterated sagittal suture.

PLATE XXX.—Group of several small irregularly-shaped osteomata such as are frequently found in the falx cerebri. The specimens are from several cases. They are photographed natural size.

NOTE.—The plates, drawings, and cases are arranged without reference to numerical order, the object being to show the progressive development of the tumor tissue from the simpler to the more complex forms. This seemed to be especially important in case of the spindle-celled endothelial sarcomata, illustrated by 31 microscopical drawings, showing the development of this tumor tissue and the degenerative modifications to which it owes its complexity.

### DESCRIPTION OF DRAWINGS.

#### SPINDLE-CELLED ENDOTHELIAL SARCOMATA.

FIG. 1 (*Case 853*).—This drawing represents the denser portion of the growth. Several cell whorls are represented, some with commencing hyaline degeneration in the central portions. Longitudinal and transverse sections of spindle-cell groups are seen running between the closely packed cell nests. Near the center of the drawing is a blood vessel with thickened hyaline wall, surrounded by circularly arranged spindle cells. The bodies of the cells, being faintly stained and closely applied to each other, are scarcely distinguishable in sections.

FIG. 2 (*Case 853*).—Section from the looser portion of the tumor, where the spindle cells are more curled and are more irregular in arrangement. Several cell whorls are represented, some showing a tendency to hyaline change in their centers. Two small hyaline spherules are seen at the left of the drawing, and capillary blood vessels in transverse and longitudinal section.

FIG. 3 (*Case 842*).—This section shows some spindle-cell bands running longitudinally, and transverse sections of three others. This tumor is almost identical with the one represented in fig. 4, *Case 774*.

FIG. 4 (*Case 774*).—In this drawing are represented parts of four lobules or groups of cells with delicate connective tissue-carrying blood vessels, running between them. The cell groups consist of cell nests and bands of spindle cells running in every direction. Some transverse sections of spindle cells may be recognized by the round sections of their nuclei. The intercellular substance is scanty and the cell bodies are hard to distinguish in the sections.

FIG. 5 (*Case 1436*).—This drawing shows the general structure of the tumor. It is seen to be composed mainly of spindle-cell elements arranged in bands and whorls. Several of the latter are shown with a few round, clear cells in their centers, visible by careful focusing. Occasionally groups of spindle cells are cut transversely, when the nuclei appear round. Two blood vessels with fibrous walls containing slender elongated nuclei are shown in the field. The stippling used for shading gives a granular appearance which is not present with low amplification.

FIG. 6 (*Case 1436*).—This drawing was taken from the line of junction between the dura and the tumor to show the gradual transition from membrane to tumor tissue. Usually the tumor structure contained many large blood vessels at the junction with the dura, and the adjoining dural vessels were engorged. The section shows two small concentrically arranged cell groups.

FIG. 7 (*Case 76*).—Section of tumor of brain, showing one very large and three small hyaline globes, and a cell nest composed of closely packed spindle cells. In the center of the large hyaline body are several nuclei and a little granular matter, and a few flattened, rod-shaped nuclei are seen between the laminae.

FIG. 8 (*Case 76*).—Section from the same tumor, showing two cell-nests and very dense hyaline bodies.



FIG. 9 (*Case 715*).—In this drawing are seen several small hyaline globules lying in the centers of cell-nests; a few small cell-nests which show no hyaline change; a longitudinal view of a cylinder of hyaline material in the center of a band of spindles, and several blood vessels surrounded by spindle cells. It is impossible to represent the hyaline material perfectly with pen and ink.

FIG. 10 (*Case 715*).—This drawing represents a very large hyaline globe from the same tumor, with its investing layers of closely applied spindle cells. Such bodies are distinctly visible to the naked eye.

FIG. 11 (*Case 715*).—Section of the tumor of the falx enlarged one-third, showing the shape of the tumor and its relation to the falx and dura.

FIG. 12 (*Case 1146*).—This section represents a spindle-celled endothelial sarcoma, which has become fibrous and has undergone hyaline degeneration, which renders the nuclei indistinct and the cells nearly indistinguishable as such. In the lower middle portion is a concentrically striated, fibrous, and hyaline body, which represents a small concentrically arranged, spherical cell mass which has become so degenerated. A number of these spherules of fibrous appearance, with scarcely visible nuclei, are seen in the middle diagonal line of the picture. These masses show all stages of degenerative change, from the spherical cell mass to the hyaline and calcified globular masses such as are represented in the drawing. The almost homogeneous appearance of the degenerated tumor tissue is represented by fine stippling, though the tissue was not granular under the microscope. The fibrous change in the cellular tissue and the hyaline degeneration gave the growth a close resemblance to hard fibroma, and in fact a considerable amount of real fibrous tissue was found present. Vessels were not numerous, and those found were imperfectly developed and hyaline. The growth was unquestionably of dural origin, though its exact histogenesis was impossible to determine.

FIG. 13 (*Case 1146*).—This drawing represents a soft carcinoma of the pyloric region of the stomach. The cells, when not influenced by pressure, are round, with prominent nuclei; when closely packed they are, of course, polymorphic. In some of the alveoli the peripheral cells show a tendency to arrange themselves in a single layer and to assume a columnar shape from mutual pressure. This is about the only trace of gland-like structure, except that the size and character of the cells suggest the fundus cells of the pyloric glands, from which they probably originated. The stroma is scanty, it forms very small alveoli, and it is less nucleated than usual in such tumors.

FIG. 14 (*Case 1146*).—This section was drawn to show the penetration of the cancer cells into the connective tissue trabeculae, between the muscular bundles of the circular layer of the muscular coat of the stomach. Two cancer cell-nests are shown lying in the midst of the dense cellular infiltration of the connective tissue. The muscular bundles are cut transversely, as the section was made parallel to the long axis of the stomach.

These two drawings were here introduced on account of the interest attached to the presence of two tumors of different character in the same subject.

FIG. 15 (*Case 1516*).—In this drawing are shown a number of hyaline spherules and three longitudinal sections of hyaline bands or rods such as were found in some parts of this growth. These rods of hyaline material are evidently of cell origin, as they sometimes show remains of elongated nuclei and are commonly found in the midst of bands of spindle cells. In some tumors of this class hyaline degeneration may affect any of the constituents of the tumor, and hyaline material may even be found in minute spherules and droplets apparently not of cell origin.

FIGS. 16-20 (*Case 1516*).—These drawings show the various stages of hyaline transformation of the cell spherules from the concentrically arranged cell groups to the hyaline spherules, which could hardly be distinguished as of cellular origin.

FIG. 21 (*Case 1516*).—This drawing shows a field from the same tumor composed of closely set cell spherules of small size, partly transformed into hyaline globes. The small spherules are separated by a little spindle-celled tissue cut in every direction. The partly hyaline spherules still show the nuclei of the cells arranged concentrically as in fig. 20.

FIG. 22 (*Case 965*).—This drawing shows the structure of this curious growth under a moderately high power. The characteristic feature of the structure is the presence of great numbers of round and oval hyaline bodies, which are believed to be the products of some form of degeneration of the closely packed cell whorls, one of which remains unchanged in the field represented. The drawing shows a number of these bodies of various sizes, some of which show calcification of their central portions. They nearly all show flattened, elongated nuclei between some of the laminae, which are supposed to be remnants of the cells of

the original cell-nests or whorls. The large body in the center of the drawing is composed of three globular bodies which have coalesced and are surrounded by a common capsule. Similar cell arrangements are seen in some tumors of this class, as shown in fig. 4, Case 774.

The cells remaining between the hyaline globes are mainly spindle-shaped, and run in bands in every direction. Sometime several layers of cells are arranged circularly around some of the hyaline spherules. In some small areas the cells seem to be nearly all round, but as the spindle cells predominate the tumor may be regarded as a spindle-celled sarcoma, or psammo-sarcoma.

FIG. 23 (Case 965).—Low-power drawing of the same tumor, showing the great number of hyaline spherules found throughout the growth, and the small proportion of cell structure which remains between them. Near the center of the drawing two of the bodies have been displaced and one is partly turned over, so that the cut edge is shown. Several empty spaces are seen in the drawing, the spherules having been displaced by the section knife. At the upper border of the drawing two spherules have coalesced; several show calcified centers, and nearly all have flattened nuclei between some of the laminae.

FIG. 24 (Case 1503).—Section showing the general structure of endothelial sarcoma of the dura mater. The drawing shows numerous cell-groups consisting of round and polygonal cells in the centers, spindle-shaped elements at the periphery, and delicate spindle-celled tissue separating them. A number of blood vessels with thick hyaline walls and scarcely distinguishable lumen are shown cut in various directions. At the lower part of the drawing a portion of one of the very large hyaline cell masses is shown. These bodies show concentric striation, the nuclei of degenerated cells, and sometimes calcification. To ordinary magnification the hyaline material is homogeneous; the stippling is used for shading.

FIG. 25 (Case 1503).—Higher-power view of the same tumor showing details of structure. Portions of several cell-groups are shown with the delicate strands of spindle-cell tissue between them. An attempt has been made to get the effect of the nearly clear cell protoplasm by fine stippling, and the difficulty of distinguishing the outlines of the round central cells is shown by faint outlines of some of the cell bodies. Four hyaline spherules of small size are shown, and two blood vessels with thickened walls lying in a small quantity of fibrous tissue.

FIG. 26 (Case 1582).—Spindle-celled endothelial sarcoma of dura mater. The section shows the general structure of the growth. Cell groups run in every direction, some closely applied to each other and some separated by what appears to be hyaline fibrous tissue. Several hyaline spherules in various stages of degeneration, are seen in the field and a small blood vessel with thick fibrous walls is shown in the middle of the drawing.

FIG. 27 (Case 1582).—Section from the same tumor showing a large curved blood vessel cut longitudinally, exposing the lumen, and several small vessels with thick fibrous, partly hyaline walls, cut transversely. The wall of the large vessel is seen to be composed mainly of spindle cells arranged circularly and in many layers. The curved portions of the vessel not in the line of section show clearly the circularly grouped cells with elongated oval nuclei, the cut portions of the wall show transverse sections of the same, and, by section of the lumen, expose the large oval nuclei of the endothelium which lie parallel with the length of the vessel. The oval nuclei in the lumen which lie transverse to the vessel are optical sections of the spindle-cell nuclei seen through the intima. I have not been able to decide as to the nature of these spindle cells surrounding the vessels, but I believe them to be the same as those composing the main mass of the tumor, and that they undergo hyaline change and form the thick-walled hyaline vessels such as shown in the next drawing. In the upper left corner is a small hyaline spherule, and in the curve of the vessel a small concentrically arranged cell group is seen.

FIG. 28 (Case 1582).—This field shows a group of blood vessels with greatly thickened and hyaline walls. In some parts of this tumor blood vessels were very numerous and were usually more or less thickened and hyaline, though some still showed the fibrous tissue or the spindle cells of which the walls were made up. The lumen was usually preserved and filled with blood, though obliteration of the vessels was only a matter of degree. The endothelium and intima were usually quite distinct and stained well, the hyaline walls stained a pale pink in hematoxylin and eosin. In the drawing fine stippling was used to represent the homogeneous hyaline degeneration and faint concentric striations to show the traces of the original constituents of the vessel walls.

FIG. 29 (*Case 1178*).—Section from spindle-celled endothelial sarcoma of the dura mater. The drawing shows the general structure of the tumor, which is composed of delicate spindle cells closely applied to each other so that the contour of the cells is scarcely distinguishable, and the tissue is mainly recognized by the cell nuclei. The tendency of the cells to arrange themselves in globular or oval whorls, which was not, however, a marked feature in this tumor, is seen in the center of the drawing, while broad curved bands of cells are shown in the general cell mass. At the lower part of the picture is represented one of the broad bands of connective tissue which intersect the tumor in every direction and separate the cell tissue into lobules. The connective tissue bands seem to radiate from the dura at the origin of the tumor; they are certainly of new growth, and they seem to form an essential part of the structure. In some tumors of this class the connective tissue is scanty; it is composed mainly of spindle cells and new fibers, but in this the tissue was dense and fibrous. The larger blood vessels were mainly found in the bands of connective tissue, but the cellular portion also contained a few vessels showing the usual imperfect walls of sarcomatous blood channels. Some round cells are found in looser portions of the sarcomatous tissue, but perhaps the most of the round nuclei lie in transverse sections of the spindle cells.

FIG. 30 (*Case 1178*).—This section, from the same tumor, shows a field containing a large blood vessel with enormously thickened hyaline wall, and two smaller vessels nearly obliterated by the same process. Some of the cellular tissue is shown, part of a sarcomatous blood channel, and some patches of dense connective tissue. In the vicinity of these large blood vessels the intercellular substance is abundant and distinctly fibrillated.

FIG. 31 (*Case 789*).—This drawing represents bands of spindle cells running between and partly encircling two large thick-walled vessels. The presence of great numbers of large and small vessels is a conspicuous feature in this tumor. Hyaline change is seen in both vessel walls; in the one it is almost complete, in the other it extends only part way around. In the right-hand vessel the endothelial lining seems to have become separated from the vessel wall and blood has escaped between them. In both of the vessels the inner portion of the wall shows proliferation of its cells and increase of connective tissue. A large number of small hyaline globules, sometimes faintly concentrically striated, sometimes homogeneous, are found in all parts of the sections. They seem to be of the same nature as the hyaline material in the vessel walls and they seem to be especially numerous in the vicinity of the vessels. I have attempted to represent the hyaline material by fine stippling, but in the sections it appears homogeneous.

FIG. 32 (*Case 1130*).—Hemorrhagic spindle-celled sarcoma of cerebellum. The section represented was taken from the tumor near the seat of hemorrhage, and the hemorrhagic infiltration of the tumor tissue is seen at the lower part of the drawing. An artery, with thick hyaline wall, is seen at the left, and the remains of another, which is totally obliterated, are seen at the upper right corner of the picture. The resemblance of transverse sections of hyaline vessels to the spherical hyaline bodies of similar growths is very striking, but in this tumor hyaline spherules were not found. Wavy bands of spindle cells, closely applied to each other, are seen in the field, and also areas of considerable size where the intercellular substance is abundant and distinctly fibrillated. Some of the round nuclei seen in these areas are probably transverse sections of the nuclei of spindle cells.

Figs. 33 and 34 are introduced to show the structure of the soft fibromata of the skin which coexisted in this case. They show some slight resemblance to the intracranial tumor, but could have had no histogenetic relation to it.

FIG. 33 (*Case 1130*).—The section represented was taken from the more cellular portion of one of the soft fibromata of the skin. At first sight the tissue bears considerable resemblance to spindle-celled sarcoma, to which it is indeed closely allied histogenetically and structurally. A close study of the growth shows that the nuclei are irregular in size, elongated, and many are curved; they lie among the fibers, and not within spindle cells, and the internuclear spaces are filled with delicately fibrillated connective tissue, which is relatively more abundant than in sarcoma. A small vein is seen in longitudinal optical section, and at the lower part a thick-walled arteriole is cut transversely. The large endothelial nuclei in the wall of the vein present a marked contrast with the nuclei of the fibrous tissue.

FIG. 34 (*Case 1130*).—This section shows the denser and more fibrous portion of one of the soft fibromata of the skin. It presents the more typical appearance of such growths. The nuclei are less numerous, more rod-like, and more curved than those shown in fig. 2. A small vessel, filled with blood, is cut transversely

in the lower part, and in the upper left corner a small collection of round nuclei represents a center of growth. Coil glands, deeper parts of sebaceous glands, deep hair follicles, etc., were found in the outer portions of the growths next to the true skin, and a few nerve fibers were occasionally found in the deeper parts of the tumors, but as these structures were only incidentally present they were not represented.

FIG. 35 (*Case 833*).—In this drawing are seen one large and several small groups of endothelial cells surrounded by spindle cells. Loose bands of spindle cells run through the growth in every direction.

Figs. 36 and 37 are given here to show the structure of the two other primary growths found in this case.

FIG. 36 (*Case 833*).—This drawing represents the common appearances of adenoid cancer of the stomach.

FIG. 37 (*Case 833*).—This section shows the small round-celled sarcoma of the testicle. In the center are the remains of a seminiferous tubule, and traces of its infiltrated wall may be distinguished around it.

FIG. 38 (*Case 539*).—This drawing shows some spindle-cell bands; portions of fields of large, round, and variously shaped endothelial cells, which were found throughout the tumor, and several large blood vessels lying in loose connective tissue. In this case the spindle cells were not a predominant feature; therefore I have called this growth an endothelial sarcoma, or endothelioma.

FIG. 39 (*Case 278*).—This section shows the general structure of the growth in the most cellular portions. Spindle-cell bands shown by the oval nuclei are represented, and groups of round nuclei with granular internuclear substance represent transverse sections of spindle-cell tissue. In longitudinal sections the stroma is faintly striated, representing the outlines of the attenuated spindle-cell bodies; in transverse section the internuclear substance seems faintly granular, and definite cell bodies can not be made out. In some places groups of round cells may be found, though these are of course hard to distinguish from transverse sections of the spindle-shaped elements. In the center of the drawing a small concentrically arranged cell group is seen, and at the upper part a blood vessel with thin walls filled with blood.

FIG. 40 (*Case 278*).—This field, from the same tumor, shows several concentric cell groups with prominent nuclei and some spindle-cell tissue. At the lower part of the drawing are groups of round cells which show no visible protoplasm. These are found in all parts of the tissue and probably represent a younger stage of the spindle cells.

FIG. 41 (*Case 278*).—Section from the same tumor represented in figs. 39 and 40. The drawing shows the junction of the growth with the dura mater from which it originated. The attachments are seen to be slight and mainly cellular, and at the left the two are mechanically separated. A lymph space filled with cells, probably of endothelial origin, is shown, the cells beginning to assume spindle shape and to form concentrically arranged groups at the left. In the central portion a small hyaline spherule is seen, surrounded by a few spindle cells. Hyaline globes were not very common in this growth, but in some places the vessel walls and bands of connective tissue showed the change in its early stages.

#### GLIOMATA.

FIG. 42 (*Case 601*).—Section of glioma of the brain, showing the various shapes of the cells, the blood vessels, and the granular and indistinctly fibrillated intercellular substance.

FIG. 43 (*Case 832*).—This drawing shows two fields drawn from different portions of the tumor. The extreme variation in the size and shape of the cells is shown. The tumor differs widely in structure in various regions of the growth, but the fields drawn seem most characteristic. The diagnosis was difficult on account of the degeneration and hemorrhage in the growth, but it was named glioma.

FIG. 44 (*Case 1053*).—Section of glioma of brain showing the general structure of the growth, the various shapes and sizes of the cells, and a small blood vessel with thick, fibrous walls. Some of the cells seem to be without nuclei, some are distinctly nucleated; the majority are more or less branched.

FIG. 45 (*Case 1053*).—Section from the looser, more degenerated portion of the same tumor. The cells, being uninfluenced by pressure, are swollen and rounded, and many are granular. The intercellular fibrous tissue is scanty. On the right is shown the half of a transverse section of a blood vessel with enormously thickened wall.

- FIG. 46 (*Case 1653*). Section from the same tumor showing a large blood vessel with peculiar grouping of the glia cells around it. These cells often show a particularly elongated branch which is directed to the vessel wall, suggesting the posteroid glia cells in some forms of gliosis. Whatever may be the significance of this disposition of the cells, they evidently have some relation to the vessel wall.
- FIG. 47 (*Case 1456*). This drawing shows a field from the ordinary structure of the tumor, stained in hematoxylin. The shapes of the cells were outlined carefully with the aid of the camera lucida; the round cells or nuclei were outlined in the same way and subsequently finished with pen shading. The pen stippling is used in these drawings merely as a method of shading; under moderate amplification the large branched and polymorphous glia cells have almost homogeneous clear cell bodies. Two large blood vessels with their contents are shown at the upper part of the drawing. The vessels have thick fibrous walls and frequently show accumulations of round cells in their vicinity.
- FIG. 48 (*Case 1456*). This section shows a portion of the same tumor containing a small area of cancer-like alveoli containing cells epithelial in character arranged in characteristic groups. These cells stain deeper than the gliomatous cells and are more granular. On the left is shown the true gliomatous tissue separated from the alveoli by a band of condensed and fibrous tissue, but evidently of the same character as the tumor.
- FIG. 49 (*Case 1619*). Glioma of brain. Field showing the general structure of the tumor in the most characteristic situations. The tissue consists of large glia cells of almost every shape, lying in a stroma made up of delicate fibrillae richly nucleated. The large, nearly homogeneous bodies of the glia cells stain faintly in the usual nuclear dyes, and the nuclei stain more distinctly but are not always visible; the apparently free nuclei stain deeply and are quite granular. The large elements are unquestionably glia cells; the nuclei may also belong to the glia tissue, but I see no reason why they may not be mesoblastic in origin as are the blood vessels and the fibrous tissue sometimes found in considerable quantity in these tumors. The intercellular fibrillae are probably, to a great extent, processes of the glia-cytes.
- FIG. 50 (*Case 1619*). Small field from the same glioma, showing better the shapes of the astrocytes and the intercellular fibrillae. A few free nuclei are seen, apparently unconnected with the fibers.
- FIG. 51 (*Case 1619*). Field from the most vascular portion of the same tumor, showing a structure composed of large blood channels, with a stroma made up of delicately-striated fibrous tissue with round and oval nuclei. The elongated nuclei probably belong to spindle-shaped cells, though no typical glia cells could be found in these situations. The walls of the blood channels apparently consist only of endothelium.
- FIG. 52 (*Case 1619*). Small field from the same tumor, showing the tissue bordering on a cyst-like space, filled with homogenous product of degeneration. Large groups of round nucleated cells of various sizes are found along the edges of these cysts of softening. They resemble the large cells found in the vicinity of cerebral softenings, and are probably altered glia cells, as shown by their resemblance to the fixed glia-cytes in the unsoftened tissue adjoining. In addition to these round cells, large fields were made up of small round elements, with distinct nuclei lying in a delicate fibrous stroma. Though these areas were vascular, they were too much degenerated to allow a definite conclusion as to the nature and origin of the cells. In general, these areas resembled inflammatory cellular infiltration, and such they may have been.

## GLIO-SARCOMA AND ROUND-CELLED SARCOMA.

- FIG. 53 (*Case 820*). This drawing represents a section from the most cellular portion of the tumor, which I have called a glio sarcoma. Several capillary vessels are seen, as the growth is very vascular. The cells are seen to vary extremely in size and shape, and are arranged in groups, probably having some relation to the blood vessels. The cell bodies can rarely be distinguished. The intercellular substance is granular, with a few fibers running through it. It much resembles the gray matter of the brain in the sections. In view of the recent opinions as to the origin of the neuroglia it may not be strictly correct to use the term glio sarcoma, though the great number of small cells with evident relation to the blood vessels suggests the presence of both mesodermic and ectodermic elements. It may perhaps be better to regard such growths as combination tumors resulting from hyperplasia of both components of the neuroglia. This tumor presented the gross characteristics of glioma. (PL. XIX.)



FIG. 54 (*Case 1237*).—Round-celled sarcoma of brain. The drawing represents the general structure of the growth selected from many sections examined. The cells are round, uniform in size, and the nuclei nearly fill the cells, so that the surrounding protoplasm is hard to distinguish and is therefore not represented in the drawing. The intercellular substance is scanty and apparently granular, but a few delicate fibers are occasionally seen. Numerous sections of blood vessels, with walls composed of endothelium and a few delicate fibers, are shown in the drawing. The vascularity of the growth and the grouping of the cells around the vessels suggest angio-sarcoma, or at least some relation of cell development to the vessels, though in other respects it is simply a vascular, small, round-celled sarcoma.

FIG. 55 (*Case 1237*).—This is a low-power view to show the advancing edge of the same tumor as it encroached upon the white substance of the hippocampus. In this tumor there seemed to be little tendency to infiltrate the tissues in advance of the tumor, but rather to gradually replace the invaded tissue as the growth grew. In the drawing the tumor tissue is shown advancing along the adventitia of a small artery, which could be traced for some distance into the sarcomatous tissue.

FIG. 56 (*Case 1237*).—The field represented in this drawing shows the border of the sarcomatous growth at its junction with a band of connective tissue, such as are found in certain parts of the tumor in the vicinity of the pia mater. As there is no tendency of the tumor structure to develop into fibrous tissue, I think it probable that these areas of fibrous connective tissue are derived from the included pia mater and are not an essential part of the growth. The drawing is intended mainly to show two concentrically striated calcareous nodules lying within the connective tissue at the border of the new growth. These bodies were very numerous in the most degenerate portions of the growth, and were found among the remnants of connective tissue and not among the cells. I have not been able to trace the origin of these bodies to alterations in the cells, and have concluded that they are essentially different from the hyaline and calcareous spherules which occur in certain spindle-celled sarcomata of the cranial cavity such as studied in case 1146, fig. 12. They are commonly lobulated or mulberry-like; they do not show traces of nuclei; are highly refractile, and they are found in situations where there is no disposition of the cells to form globular aggregations and to undergo hyaline change. They are supposed to be identical with the calcified granules found normally in the pineal gland and choroid plexus, known as *brain sand* (*acervulus cerebri*), and if so, they are different in origin from the hyaline and calcified cell spherules of the spindle-celled endothelial sarcomata studied in this and former reports, though the two are commonly confused by observers on account of the resemblance between them.

#### PITUITARY ADENOMATA.

FIG. 57.—Section of normal adult pituitary body, showing the different kinds of epithelium in the acini and the arrangement of the cells. In some of the cells are globules of colloid material.

FIG. 58.—Section of normal pituitary body showing columnar cells imperfectly lining the acini, etc.

FIG. 59.—Section from the pituitary body near the junction of the anterior and posterior lobes. Duct-like structures lined with columnar cells and filled with granular colloid material, and large, clear, rounded cells contained in small alveoli are represented. Figs. 57, 58, and 59 are introduced to compare with the sections of the adenoma of the pituitary body found in case 788.

FIG. 60 (*Case 788*).—This section is from the denser part of the adenoma of the pituitary body where the acinous arrangement is most perfect. The connective tissue septa carry the blood vessels and are covered by a more or less perfect layer of columnar cells. Small papillary outgrowths are seen to arise from some of the walls of the acini, and three transverse sections of similar processes are seen in the large acini. The central portions of the acini are filled with rounded and polygonal cells without any indication of central cavity.

FIG. 61 (*Case 788*).—Section from the acinous portion of the pituitary adenoma showing several small alveoli and a duct-like structure lined with columnar cells and containing granular colloid material. Compare with fig. 59.

FIG. 62 (*Case 788*).—Section of small areas found in the pituitary tumor, where the cells are large, round, with clear or slightly granular protoplasm, and show but a trace of columnar arrangement. Compare with fig. 59.

FIG. 63 (*Case 788*). Section showing the general structure and arrangement of the looser portions of the pituitary adenoma. The papillary outgrowths are cut in every direction, showing that they are more or less cylindrical and covered by columnar cells. The interpapillary spaces are sometimes filled with loose cells similar to those filling the alveoli in the denser portions, or they may be empty, or, more properly, filled with fluid during life.

FIG. 64 (*Case 788*). High-power view of some of the papillary processes represented in fig. 63. The central fibrous tissue of every papilla contains a blood vessel. This, and the section from which fig. 63 was drawn, were fixed to the slide before removing the infiltrating material, so that the exact relations of the elements are preserved.

FIG. 65 (*Case 870*). High-power view of the tumor of the pituitary body. The drawing represents one complete alveolus and parts of three others. The alveoli are very large; one of the smallest is shown in the drawing. The long, columnar cells, curiously modified by mode of growth and mutual pressure, are seen to form an almost perfect lining to the alveolus, and appear to be proliferating and throwing off cells to fill the interior. The cells which fill the central cavity of the alveolus are generally rounded, but show almost every conceivable shape caused by mutual pressure. The central mass of cells is almost always separated from the parietal layer by a space which is probably the result of shrinkage in hardening. Papillary outgrowths from the alveolar walls are rarely found in the portions of the tumor examined, but in other respects the structure is practically identical with the adenoma of the pituitary body represented by fig. 60, case 788. The alveolar walls are composed of mature connective tissue well supplied with blood vessels.

### SERIES I. SPINDLE-CELLED ENDOTHELIAL SARCOMATA.

Of the twenty-eight true intracranial tumors studied in this monograph no less than seventeen belong to the class of growths commonly called endotheliomata, but which, on account of their structure, supposed cytogenesis and histogenesis, the writer has named spindle-celled endothelial sarcomata; spindle cells being the predominating type of elements, and the endothelium of the dura mater and probably the soft membranes being the origin of the growths.

These tumors can not be classed with any other division of morbid growths, consequently they must be placed with the sarcomata or in a class by themselves. They are cellular tumors of embryonic character and of mesodermic origin, and are thus naturally placed with the sarcomata, though they differ in many important particulars from the ordinary sarcomas.

They commonly, if not always, arise from the dura mater or one of its extensions, as flat, wart-like tumors, usually of small size, but may reach two inches or more in diameter. They are intimately but not firmly attached to the dura, and when mechanically detached from the membrane leave the surface slightly roughened but usually intact. The fact that the growths, being friable and soft, are easily torn from their seat of origin and leave the membrane apparently nearly normal, has, I think, led to mistakes as to the derivation of some tumors of this class, the slight attachments to the dura being mistaken for inflammatory adhesions.

In the course of their growth the dural tumors slowly penetrate the brain, making at first a slight depression in the surface without destruction of tissue. As they increase in size they push the pia mater and cortex in front, usually become incorporated with the soft membranes, and when of considerable bulk produce destructive softening of the cortex and white matter in the vicinity. Sometimes the mem-



branes and cortex are destroyed to such a degree that the growth seems to directly invade the white matter, and large tumors lying within the brain with relatively small dural surface may easily be mistaken for growths of the pia or brain substance.

These growths are usually solitary, but in two or three of my cases more than one nodule was found. They may occur at any part of the dura, as no local cause appears necessary. The bone is sometimes slightly roughened and elevated, and the dura thinned beneath the site of the tumor, but this is probably the effect and not the cause of the new growth.

These tumors do not invade the tissues by infiltration, and at the same time no distinct capsule can be demonstrated, the limiting surface being merely a condensation of the peripheral cell elements in contact with the tissues invaded. Remnants of the pia mater forced in advance of tumors penetrating the brain have been mistaken for a connective-tissue capsule, but no such tissue is found on the free surface of the smaller dural nodules. The growth is evidently slow, and they do harm by mechanically invading the brain; they are sharply circumscribed, and when penetrating the brain in regions of known function they may be accurately located; and, if accessible, they should be removed before they reach great size and seriously damage the brain.

The exact histogenesis of these tumors is in many cases hard to determine. In most of the writer's cases a dural origin was highly probable, and in two growths of the series there was unmistakable evidence that the tumor cells originated from the proliferated endothelial cells covering the arachnoid villi penetrating the parasinoidal and lymph spaces of the dura in the vicinity of the falx cerebri. The evaginations of the arachnoid carry with them the endothelial layer of the surface, and push in advance the endothelial and sub-endothelial layers of the dura mater, the two cell layers being in microscopic contact. In the tumors in question it seemed to be chiefly the arachnoid endothelium that showed active proliferation and entered into formation of the new growths. Over some of the arachnoid villi the cells were seen to be several layers thick, at first rounded or polygonal from mutual pressure, and finally becoming elongated and spindle shaped as they extended in long cell processes to join the main tumor mass at the necks of the villi. The peculiar tendency of the tumor cells to arrange themselves into concentric groups and to undergo hyaline change was manifested while they yet occupied the arachno-dural interspaces. Some cell-spherules and hyaline bodies were found within these narrow channels, as shown in fig. 41, case 278.

The structure of these growths varies somewhat in individual cases, but a general description would answer for most tumors of the class. They are made up for the most part of delicate, slender spindle cells, with elongated oval nuclei and clear cell-bodies. In the denser spindle-cell portions the cells are closely applied to each other without distinguishable intercellular substance, and the tissue much resembles richly nucleated fibrous tissue, as it is extremely difficult to differentiate individual cells. In other growths and even in other portions of the same tumor, there may be a more or less abundant fibrillated intercellular matrix, which doubtless has led to the description of such varieties as fibromata.

Examination of the developing borders of these growths shows that the cells are at first rounded or polygonal, and that the spindle shape is a later stage of development. In some tumors many of the cells remain embryonic and endothelioid, sometimes arranged in groups with a spindle-celled stroma forming an alveolar structure. In this respect these tumors do not differ materially from ordinary spindle-celled sarcomata of the endothelial type.

In some tumors connective tissue is present in considerable amount, sometimes forming alveoli, in which lie groups of variously arranged spindle cells. In some cases the fibrous tissue forms broad bands running in every direction through the tissue and carrying the principal blood vessels; again this tissue may be scanty and may be mainly resolved into spindle cells and delicate fibrils, apparently the transition stage between the spindle-cell tissue and the more mature connective tissue.

The blood-vessel walls are mainly composed of an endothelial intima, with a more or less thick fibrous investment. In the most cellular portions the walls are usually thin, being composed of an endothelial coat with a few connective-tissue fibrils arranged both circularly and longitudinally. In some tumors the vessels are often surrounded with many layers of circularly disposed spindle cells, apparently identical with the tumor elements. Hyaline degeneration is very common in the walls of the vessels, affecting both fibrous tissue and spindle cells; and occasionally the walls are greatly thickened and the lumen nearly or quite obliterated. See figs. 24-31.

Though these tumors differ in many respects from the ordinary sarcomata, they belong to the connective-tissue group of new growths, and we must regard both the blood vessels and the connective tissue as essential parts of the structure. We find also in these growths as in ordinary sarcomas, the tendency to develop from the embryonic to the more mature forms of mesoblastic tissue.

In all tumors of this class there is a marked tendency for the cells to arrange themselves into whorls, or concentrically grouped cell spherules separated from each other by longitudinal groups of spindle cells. These groups are often further separated into large alveoli by connective-tissue septa, as seen in fig. 4.

The cause of this peculiar mode of growth can not be well explained. It may possibly be due to cell development from certain centers, the peripheral layers being flattened into spindle shapes by pressure. It may also be related to the early development of the cells from the connective-tissue lymph spaces or the endothelium of the lymph vessels. So far as I know this peculiarity of cell growth is confined to tumors of the dura mater and possibly of the soft membranes, so that it may depend upon some histogenetic factor not yet explained.

Some of the concentrically arranged cell masses contain distinct central groups of round endothelioid cells surrounded by several layers of spindle cells. In the apparently older cell spherules the endothelioid cells are less evident, and those remaining have frequently become hyaline.

In some tumors large groups of endothelioid cells unchanged into spindle-shape remain in certain fields; but in such there are always some spindle elements which give character to the growth (fig. 38).

These tumors are peculiarly liable to hyaline degeneration, and subsequent calcification. It may affect the cell spherules, the spindle-cell

bands, the vessel walls, the connective tissue present, and hyaline material may even exist as small, free, concentrically striated globules in the vicinity of the blood vessels and elsewhere, as seen in fig. 31. When affecting the concentric cell groups, it produces the peculiar hyaline spherules for which these tumors are noted; in the longitudinally disposed bands of cells it forms the cylindrical and lanceolate deposits found in some tumors; in the vessel walls it results in great thickening and even obliteration of the lumen; and in the connective tissue it converts whole fields into glassy, almost structureless, tissue, with a few persistent nuclei.

It is the object of the arrangement of the drawings and cases to show the gradual retrogression of the cell groups into the hyaline and often calcified spherules and lanceolate deposits which have led to the improper use of the term psammoma for such tumors.

The writer is convinced that the hyaline globes originate in the degeneration of the cell groups and that the hyaline and calcified rods are of the same nature. The degeneration begins in the center of the cell groups, probably from malnutrition of the central cells as these masses are avascular; it proceeds outward until it may involve the whole group, though commonly a few layers of peripheral elements remain unaffected. The greatest degree of change converts the cell group into a faintly concentrically striated spherule, sometimes calcified in the center with only the flattened remnants of nuclei to show the former cell structure.

It is the writer's opinion, based upon the study of a number of these tumors, that these hyaline and sometimes calcified spherules should be clearly distinguished from the somewhat similar calcified bodies which are frequently found in the pineal gland, choroid plexuses, degenerated products, and growths; and are known as "brain sand;" and, that to call tumors, such as above described, psammomata, acervulomata, etc., is incorrect.

Though these tumors must be placed in the general class with the sarcomata they are not malignant in the usual sense of the term. They seem to have no tendency to invade the adjoining tissue by infiltration, apparently increasing in size by interstitial cell growth as a mass. On this account they are frequently much smaller at their dural attachment than the part within the brain. The study of the origin, the mode of growth, and the histology of these peculiar growths leads to the conclusion that such tumors when accessible may be removed with the assurance that there will be no recurrence *in situ*, and that the brain lesion, if not too great, may be repaired with the preservation of life and reason.

#### CASE 853.

##### SPINDLE-CELLED SARCOMA OF BRAIN.

C. S.; aged 73 years; married; laborer; late soldier; nativity, Germany. Mental disease, senile dementia; duration over three and a half years. The degree of dementia was great; memory was bad; sight and hearing impaired; general muscular feebleness, but no distinct paralysis. There was a history of occasional vomiting, which may or may not have been of cerebral origin, but with this exception the usual symptoms of intracranial tumor were absent, and the above mental and

physical symptoms were attributed to senility. The patient sank gradually and died of exhaustion and diarrhea.

Autopsy twenty-one hours after death. Body showed some emaciation; rigor mortis passing off.

*Cranium.*—Skull rather thick and dense; sutures nearly obliterated. Shape almost symmetrical; antero-posterior diameter  $7\frac{1}{4}$  inches; transverse,  $6\frac{1}{2}$  inches. The dura mater was generally slightly thickened and was firmly adherent to the bone. Over the inner surface of both sides was a thin false membrane of internal pachymeningitis, and on the right side over the parietal region were three small nodules of whitish tissue which projected inward. The falx major was considerably thickened generally, and about its middle were several nodules similar to those above described, but of larger size. The falx was more firmly adherent to the pia mater in the vicinity of these growths than elsewhere, and the pia was torn by its removal. None of the small dural growths were large enough to press injuriously upon the brain, as they were flat in shape, and the largest did not project over one-fourth of an inch above the general surface of the membrane.

Brain: Weight of right hemisphere,  $20\frac{1}{4}$  ounces (588.26 grams); left hemisphere,  $20\frac{1}{4}$  ounces (574.08 grams); cerebellum, pons, and medulla, 6 ounces (170.10 grams). Pia mater slightly opaque; arteries at base of brain atheromatous, distorted, and irregularly dilated. Convolutions were atrophied over the whole brain, but somewhat less so at the base. By palpation a hard mass was found in the right hemisphere at the junction of the temporal and occipital lobes. Section revealed a tumor in the white matter about  $1\frac{1}{2}$  inches in diameter and nearly globular in shape. A section made at right angles to the long axis of the hemisphere and about half an inch posterior to the splenium of the corpus callosum, passed through the center of the tumor.

On superficial examination the tumor appeared to have originated in the white matter, as it seemed to be at no place in contact with the cortex or pia mater. At the posterior portion of the lateral ventricle the growth was only separated from the cavity by the thickened ependyma, and in the descending horn the choroid plexus was adherent to the ependyma and the hardened exterior of the tumor. A small white fimbriated body seemed to extend from the wall of the tumor into the descending cornu and to become adherent to the choroid plexus. It was quite similar in texture and appearance to the thickened ependyma and may have been the corpus fimbriatum altered by inflammatory changes. The proximity of the growth to the ependyma, choroid plexus, falx, and tentorium, and the presence of similar growths on the dura mater, suggest that the tumor probably originated from the membranes rather than from the brain substance.

The growth encroached upon the gyrus fornicatus and the hippocampal convolution from within, but there were no evidences of pressure externally and no signs of increased intracranial tension.

The tumor appeared to be sarcomatous in its nature. It was firm, granular on section, reddish gray in color, and seemed to be separated from the brain substance by a condensed exterior or an imperfect capsule. In the center was a small hard mass, which could not be cut with the knife, probably a calcified portion, and small gritty granules were distinguished throughout the growth. The brain tissue in the vicinity of the tumor was extremely soft, so that it was difficult to keep the growth in place while making the sections through it. To the naked

eye the dural tumors appeared similar to the cerebral growth in consistence and composition.

On the left side a softening involved the head of the caudate nucleus and extended slightly into the internal capsule; the lenticular nucleus was full of small brown softenings and there was extensive softening of the optic thalamus. On the right side there was a small softened area in the head of the caudate nucleus and several in the thalamus and lenticular nucleus. The general consistence of the brain tissue was reduced; perivascular spaces enlarged. No tumor deposits or other gross lesions were found in the cerebellum, pons, and medulla.

*Thorax.*—Pleural cavities normal. Weight of left lung, 27 ounces (765.45 grams); right lung, 28½ ounces (807.97 grams). Anterior margins emphysematous; posterior portions were engorged and oedematous.

Heart: Weight, 13 ounces (368.55 grams). Pulmonary valves normal; tricuspid valve admitted four fingers, but was otherwise normal. Aortic valves much thickened and rigid; mitral valve greatly thickened at its margins. Heart cavities slightly dilated and the walls flabby and relaxed. The aorta was somewhat atheromatous at its upper part and the abdominal portion was much diseased.

*Abdomen.*—The spleen weighed 7¼ ounces (219.71 grams); capsule wrinkled and thickened in patches; pulp very soft.

Kidneys: Weight of each, 4 ounces (113.40 grams). Capsules not adherent; surfaces smooth; some increase of pelvic fat. Urinary bladder normal.

Liver: Weight, 47 ounces (1,332.45 grams). Tissue normal, except some post-mortem softening. Gall-bladder contained about 2 ounces of dark bile.

Other abdominal organs showed no signs of disease.

#### MICROSCOPICAL EXAMINATION.

**Tumor:** The tumor consisted mainly of delicate spindle cells arranged in wavy bands and whorls, which were found without definite order throughout the growth. The individual spindle cells were slender, more or less wavy, with elongated oval nuclei which stained with great brilliancy in nuclear stains, while the cell bodies remained nearly unstained. In some portions of the growth the cells were separated by a variable quantity of faintly fibrillated intercellular substance, giving a looser appearance to the tissue; in other places the cells were densely packed and arranged in definite bands and cell whorls. A little connective tissue was sometimes found between the denser cell masses, and blood vessels were found occasionally in the connective tissue and also in the midst of the cell masses. A few of the larger blood vessels showed thickened hyaline walls; the capillary blood channels had more or less distinct walls, and ran in every direction through the cell masses.

A few of the concentrically arranged groups of cells showed commencing hyaline change in their central portions, and in some parts of the tumor hyaline spherules were numerous. They usually showed distinct lamination, and in almost all, flattened elongated nuclei were distinguishable between some of the laminae, suggesting their origin from the cell-whorls. Many of the hyaline bodies showed many layers of concentrically arranged spindle cells around them. So

partly calcified in their centers, but the section knife usually passed through them when they lay in the plane of the section.

In some parts of the tumor it seemed that the bands of cells had become hyaline in their centers, and coiled and interlaced hyaline cylinders lay among the cells. The exact nature of these hyaline structures could not be determined.

In limited fields of some sections groups of rounded endothelioid cells were found, lying among the fasciculi of spindle cells. They were undoubtedly polygonal in shape, with round nuclei, and were easily distinguished from transverse sections of spindle cells. To growths showing a predominance of such cells the name endothelioma is given, but, as in this case, the main bulk of the growth was composed of spindle cells, it may be regarded as a spindle-cell sarcoma, probably of endothelial origin.

Sections from the peripheral portions of the growth showed an imperfect capsule of connective tissue which limited the tumor, and there was no infiltration of the brain substance. The origin of the growth could not be determined by the microscopical examination, but its exact resemblance to the dural tumors studied in other cases, and the resemblance to the small growths found on the dura in the same case, suggest that it may have originated from the dura mater at some point not discovered.

The small tumors in the dura mater were in all essentials identical with the cerebral growth except that they were more vascular.

The brain showed some tortuosity of the blood-vessels, enlargement of the perivascular and pericellular spaces and advanced degeneration in the nerve-cells. The spinal cord seemed normal. The other organs showed nothing of importance in addition to the naked-eye appearances.

#### CASE 842.

##### SPINDLE-CELLED SARCOMA OF DURA MATER.

T. K.; aged 67; single; late soldier; nativity, Ireland. Mental disease; chronic dementia; duration, unknown. This patient was much demented at the time of his admission, so that the impairment of the special senses could not be well determined. The sense of smell must have been destroyed, and sight was probably impaired, though he was not blind. He was restless and destructive, but he was confined to his bed on account of muscular enfeeblement. The typical symptoms of brain tumor were not present, though the dementia may have been a symptom, and he had at least one convulsive attack, which occurred about twenty-four hours before his death.

Autopsy twenty-one hours after death. Body fairly well nourished.

*Cranium*.—Antero-posterior diameter, 7½ inches; transverse, 5¼ inches. Skull asymmetrical, the left side being the larger, and the internal occipital protuberance was situated to the right of the median line. The frontal bone was a little thicker than usual; Pacchionian and vascular depressions wide and deep; diploë congested; sutures partly obliterated. The dura mater was generally adherent to the bone, and on the inner surface at the vertex was a thin false membrane of pachymeningitis. Over a small area, about an inch posterior to crista galli, corresponding with the body of the sphenoid bone, the surface was raised into a rough prominence about three-sixteenths



of an inch above the level of the bone. At this situation the dura adhered firmly to the rough surface, and the inner surface of the membrane was adherent to a tumor mass which was imbedded in the orbital surface of the frontal lobes. The dura at this point was partly destroyed, but an imperfect layer of the membrane still intervened between the tumor and the bone. The olfactory fossæ were still unaffected in front of the diseased bone, but there were no traces of the anterior portions of the olfactory nerves.

Brain: Weight of right half, 24½ ounces (694.57 grams); left half, 24 ounces (680.40 grams). In the orbital surfaces of the frontal lobes was a large tumor, situated in the median line, and apparently equally divided between the two hemispheres. The growth measured about 2½ inches in diameter; it was roughly globular, with a shallow depression in its under surface which corresponded with the elevation on the surface of the bone. The tumor appeared to have originated from the dura mater, and it had penetrated the brain and pushed aside and destroyed the structures with which it came in contact. Over the outer portion of the tumor the pia mater and the arachnoid were tightly stretched, indicating that the tumor had grown laterally after penetrating the brain. The growth extended from about half an inch anterior to the optic chiasma to within about the same distance from the anterior extremity of the frontal lobes. The anterior portions of the olfactory nerves were involved in the tumor growth and destroyed; their posterior portions were not affected. There appeared to be no pressure upon the optic nerves, and no evidences of disease were visible to the naked eye.

Incision in the median line showed that the growth had pushed aside and destroyed the convolutions of the lower part of the median surfaces of the frontal lobes, and had pressed the genu of the corpus callosum, the anterior cerebral arteries, and the septum lucidum upward and backward. The orbital convolutions were pressed aside and destroyed, but the tumor was situated too far anterior to encroach upon the third frontal convolutions except somewhat upon the lower portions.

One-half of the tumor was enucleated from its depression in the brain and the surface was found to be rough, somewhat nodular, and slightly adherent to the remnants of pia mater at the bottom of the depression. There appeared to be a distinct fibrous capsule, probably remains of the pia mater, in which large blood vessels could be seen. The falx cerebri extended deeply into the tumor and adhesions had formed on both sides of it.

On incising the tumor the knife came in contact with a hard calcareous mass, of considerable size, which required the use of the bone forceps to cut it through. The growth was reddish-gray in color, and punctiform hemorrhages could be seen on the cut surface. The consistence was firm, cut surface granular in appearance and dry.

The brain tissue in the vicinity of the growth was very soft, and there was œdema and general reduction of consistence of the brain substance and enlargement of the perivascular spaces. The convolutions were slightly flattened over the frontal lobes; there was some atrophy over the convexity, and a slighter degree in other regions. The pia mater over the upper portions of the convexity was slightly opaque; veins engorged; arteries at the base atheromatous and distorted; ventricles slightly encroached upon by the tumor pressure; ependyma normal.



The cerebellum, pons, medulla oblongata, and cervical cord showed nothing of especial interest.

*Thorax.*—Weight of right lung, 24½ ounces (701.66 grams); left, 20 ounces (567 grams). The anterior margins were emphysematous, and the posterior portions were hypostatic. Bronchial glands deeply pigmented.

*Heart:* Weight, 13 ounces (368.55 grams). Pulmonary valves very thin and easily torn; tricuspid valve normal; aortic valves were thickened, contracted, and at line of contact were some chronic vegetations; margins of mitral valve somewhat thickened; heart muscle flabby, and the wall of the right ventricle was encroached upon by the superficial fat. The aorta was very atheromatous and the arch was greatly dilated.

*Abdomen.*—The spleen weighed 5½ ounces; capsule wrinkled; pulp dark and very soft.

*Kidneys:* Weight of left, 5¼ ounces (148.83 grams); right, 4½ ounces (134.66 grams). Capsules easily removed; surfaces smooth; the left contained a moderate-sized cyst, otherwise the organs seemed normal. Urinary bladder, normal.

*Liver:* Weight, 46½ ounces (1,325.36 grams). Tissue showed slight passive congestion. Gall-bladder contained 3 ounces of thick bile.

Stomach, intestines, and other abdominal organs were normal.

#### MICROSCOPICAL EXAMINATION.

The tumor is in every essential identical with the one found in case 774. The spindles are exactly the same, but the arrangement into whorls, or cell-nests, is not so conspicuous. A few cell-nests are found in every field, but they are generally small, and hyaline globes are rarely found. Bands of spindle cells run in every direction, so they are cut in every possible way in the sections. The blood vessels are not numerous; they are found in the delicate connective tissue which intersects the cell groups, and sometimes in the midst of the spindle cells.

The drawing from this tumor represents longitudinal and transverse views of bands of spindle cells. The distinction between the individual cells in transverse sections is very difficult when the cells are closely packed; the effect is that of a homogeneous, or faintly granular, ground substance, in which lie the small round transverse sections of the nuclei of the spindle cells.

The nerve-cells of the brain are excessively pigmented, granular, and many are partially disintegrated at their margins. The pericellular and perivascular spaces are enlarged. Many of the small vessels are very tortuous, and around many are accumulations of leucocytes, blood cells, and pigment. This condition of the vessels is seen everywhere, but it is especially marked in the vicinity of the tumor. Spider cells are found in the outer layer of the cortex, and the neuroglia is coarsely fibrous. Near the tumor the tissue shows great numbers of spider cells, increase of nuclei, and other evidences of irritation of the brain tissue. The cerebellum, pons, and medulla show nothing of special interest.

In the examination of the other organs nothing of importance was found.

## CASE 774.

## SPINDLE-CELLED SARCOMA OF DURA MATER.

L. H.; aged 63; widower; late soldier; nativity, Germany. In this case there were many of the symptoms of brain tumor. The patient was much demented; was totally blind; had convulsive attacks, and had general paralytic symptoms, but without distinct paralysis. Headache and vomiting were not marked symptoms during his stay in this hospital. The duration of the mental disease was given as three years and nine months.

Autopsy ten hours after death. Body fairly well nourished; bullet wound on outer surface of right thigh.

*Cranium.*—Antero-posterior diameter of skull,  $7\frac{3}{8}$  inches; transverse, 6 inches. Skull thinner than usual and slightly asymmetrical, the right side being unusually prominent. The dura mater was thicker than normal, and adhesions between it and the pia mater along the median edges of the hemispheres were firmer than normal, so that the removal of the dura brought away portions of the pia mater with it.

Brain: Weight of right half,  $27\frac{1}{2}$  ounces (779.62 grams); left half, 30 ounces (850.50 grams). A large globular tumor about  $2\frac{1}{2}$  inches in average diameter occupied the basal portions of the frontal lobes. The tumor had apparently originated from the dura mater, as it was firmly adherent to the membrane and bone over an area of about an inch and a half, and at this situation the dura had nearly disappeared and the bone was roughened and elevated. The tumor had grown almost in the median line and penetrated the frontal lobes as a nearly globular mass, the larger half of which lay in the left hemisphere. The tumor had by its growth into the brain displaced and destroyed the olfactory nerves, except a small portion of their roots; pressed upon and involved in inflammatory adhesions both optic nerves; pushed aside and destroyed the orbital convolutions, the lower convolutions of the median surfaces of the frontal lobes, the anterior portions of the third frontal convolutions, and had pushed the anterior cerebral arteries and the genu of the corpus callosum upward and backward.

The growth had extended laterally in the left hemisphere so that it was only about one-fourth of an inch beneath the surface of the anterior part of the third frontal convolution; on the right side the corresponding convolution was much less affected. There was no appreciable displacement of the basal ganglia and the insular lobes, but the anterior walls of the ventricles, the lamina cinerea, anterior pillars of the fornix, and septum lucidum were crowded backward by the pressure upon the parts in front of them. The tumor extended from about half an inch anterior to the optic commissure to within half an inch of the anterior extremity of the frontal lobes.

The tumor was grayish red in color, firm, and was granular or nodular on the surface. Section showed the interior to be about the same color, dry, and mottled with small hemorrhagic foci. In the vicinity of the tumor the brain substance was extremely soft, so that it was difficult to keep the tumor in place during the section of the brain. The tissue seemed to have been to a great extent absorbed or destroyed, but the tumor was circumscribed by an imperfect capsule and the brain substance was not infiltrated. In places where the pressure was not so great, as around the periphery at the base, traces of c

pia mater could be distinguished. The anterior portion of the falx was adherent to the tumor by inflammatory adhesions, but was not otherwise involved by it.

The convolutions generally were somewhat flattened against the bone, more noticeably over the frontal lobes. There was great œdema in the vicinity of the tumor, and the brain tissue was very pale and soft for some distance from it; the consistence elsewhere was slightly reduced, and the perivascular spaces were enlarged, showing chronic œdema of the brain. The convolutions showed some atrophy over the whole brain. The section showed no other gross lesions in the brain; the ventricles were not dilated, and the ependyma was smooth. The arteries at the base showed no disease, except slight atheroma of the intracranial portions of the carotids. The cerebellum, pons, and medulla showed no gross lesions.

*Thorax.*—The right lung weighed  $24\frac{1}{2}$  ounces (687.48 grams); the left, 15 ounces (425.25 grams). They showed a slight excess of blood, some emphysema of anterior margins, some old pleural scars, and some calcareous nodules at the apices.

*Heart:* Weight, 13 ounces (368.55 grams). An opaque patch over anterior wall of right ventricle. Pulmonary valves normal, tricuspid orifice slightly enlarged; aortic valves a little thickened; mitral valve thickened, contracted, and some vegetations were found along line of contact. The chordæ tendineæ were thickened and shortened so that though the orifice was normal in measurement, the valve was probably incompetent. There was slight hypertrophy and dilatation of all the cavities.

*Abdomen.*—Weight of spleen,  $3\frac{1}{2}$  ounces (92.13 grams), capsule adherent to the structures in the vicinity; pulp tough and fibrous.

*Kidneys:* Weight of left,  $4\frac{1}{2}$  ounces (120.48 grams); right, 4 ounces (113.40 grams); capsules easily removed; general appearances normal; urinary bladder normal.

*Liver:* Weight,  $44\frac{1}{2}$  ounces (1,261.57 grams). The tissue contained a slight excess of blood. Gall-bladder contained an ounce of bile and one rough calculus.

#### MICROSCOPICAL EXAMINATION.

The tumor is composed of spindle cells with oval and elongated nuclei arranged in closely packed bands and whorls. The bands of cells are found to run in every direction and were sectioned at all angles to their course, thus giving peculiar appearances in different parts of the sections. The most characteristic arrangement of the cells is the formation of dense whorls or circles of cells, with sometimes one, sometimes two or more centers around which the cells are closely applied. These centers of cell-nests are surrounded by concentric bands of cells forming groups or lobules, which are partly separated from each other by delicate bands of connective tissue. The appearance of the cell-nests is extremely like those of epithelioma, but whereas the "nests" of the epithelial cancer are composed of squamous cells, which appear like spindle cells in optical section, in the present tumor the cells are without doubt true spindle cells. They never appear as squamous cells, but when cut in transverse direction they show conclusively that they are actual spindles with elongated nuclei. Transverse and oblique sections of spindle cells are seen in the cell-whorls showing that they are applied in every direction around the centers. In the cen

cell-whorls are seen several nuclei with clear or faintly granular protoplasm around them. I have not been able to resolve this protoplasmic center into cells, chiefly because it seems to be generally more or less changed into hyaline material, but I think it reasonable to conclude that the central cells of the cell-nests are spheroidal or polyhedral, as they undoubtedly are in similar cell arrangements in closely allied tumors. See case 1436, fig. 5.

A few laminated hyaline globules are found, but this feature is not a conspicuous one in the present tumor. Many of the cell-nests show the tightly packed cells and glistening protoplasm in their centers, which may be the early stages of hyaline change.

The blood vessels are not numerous; they have imperfectly developed walls, as a rule, though some have thick, fibrous walls, and some are found surrounded by a few layers of spindle cells. The larger vessels are found in the connective tissue bands which intersect the groups of cells; small blood channels with a small amount of adventitial fibrous tissue are found in the denser masses of cells.

Peripheral sections show that the tumor has an imperfect fibrous capsule containing blood vessels, which is continuous with the fibrous tissue within the tumor. The looser connective tissue in the tumor contains many spindle cells and probably is of similar derivation.

Nothing of special interest is found in the brain. The nerve-cells show granular degeneration of the cell bodies, but the nuclei are usually well preserved. Some of the cell spaces contain only clumps of yellow granules, the remains of degenerated cells. The nerve cells of medulla and cord show an excess of pigmentation. The kidneys show slight epithelial degeneration. The other organs were not examined with the microscope, but were supposed to be normal.

#### SPINDLE-CELLED ENDOTHELIAL SARCOMA OF THE DURA MATER AT BASE OF BRAIN.

##### CASE 1436.

J. C.; aged 64; married; blacksmith; late soldier; nativity, New York. Mental disease, chronic dementia; duration, over one year.

In this case there were no symptoms of intracranial tumor, the growth being small and having not encroached upon important structures. There was a general paralytic condition which was fully accounted for by the organic disease of the brain found post-mortem. The patient was much demented and could not well describe his symptoms, but so far as could be observed had no pain or disturbance of special senses. He died suddenly, with symptoms of apoplexy, probably induced by the organic disease of the brain.

Autopsy twenty-two hours after death. Body large and well developed; head and neck deeply congested; hydrocele of right side.

*Cranium.*—Skull symmetrical, of usual shape and thickness. Antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse,  $5\frac{1}{4}$  inches; sutures visible externally, indistinct in inner table; arterial depressions well marked.

The dura mater was adherent to the bone, of usual thickness, and contained a small osteophyte in the falx.

At the base, resting upon the anterior clinoid process, was a dural tumor about half an inch in diameter and about one

an inch in thickness. The growth was firmly adherent to the dura, incorporated with it, and evidently had originated from the membrane. The bone was slightly roughened beneath the tumor, but though the growth was in close relation to the carotid artery, optic nerve, and cavernous sinus, it had not pressed upon those structures. The tumor was grayish-red in color, somewhat rough on the surface, and to the naked eye resembled the common form of dural endothelioma.

**Brain:** Weight of left hemisphere, 470 grams; right hemisphere, 550 grams; cerebellum, pons, and medulla, 200 grams. The tumor had made no depression in the brain and was not adherent to it. The vessels were much engorged; subdural fluid tinged with blood; arteries not diseased. The convolutions were generally shrunken, and on the left side were extensive softenings, involving the anterior and lower part of the frontal lobe, the anterior portion of the temporal lobe, and the whole island of Reil. No lesions in the interior nor on the right side. The tissue was yellowish, soft, and œdematous, and the perivascular spaces were enlarged. Cerebellum, pons, and medulla were in the same general condition as the cerebrum, but showed no gross lesions.

**Thorax.**—The lungs were deeply pigmented with carbon and hypostatic posteriorly. Weight of the left, 550 grams; right, 650 grams.

**Heart:** Weight, 470 grams. Organ flabby and soft; auricles and ventricles dilated. Right valves not diseased; tricuspid valve relatively incompetent. Aortic valves were slightly thickened and adherent to each other, but probably fairly competent. Mitral valve normal.

**Abdomen.**—Spleen weighed 90 grams. The capsule was wrinkled pulp, soft.

**Kidneys:** Weight of each, 200 grams. Capsules slightly adherent; surfaces granular and showed numerous small cysts; cortex thin; pyramids small, and the pelvic fat was increased. Though much shrunken, the weight was not below the normal, the organs having been originally large.

**Liver:** Weight, 1,190 grams. The tissue had been normal, but was softened by decomposition.

Other organs presented nothing of importance.

#### MICROSCOPICAL EXAMINATION.

The tumor was found to belong to the class commonly called dural endotheliomata, but which perhaps are better designated by the term spindle-celled endothelial sarcomata. The main mass of the growth was made up of delicate spindle cells, with oval granular nuclei closely applied to each other, so that in the dense masses individual cells were hard to distinguish, and the structure of the tissue was mainly recognized by the direction and shape of the nuclei. The cells were arranged in wavy bands running in every direction and in concentrically arranged groups, which are a characteristic feature in tumors of this class. These cell spherules in this growth seemed to consist of many layers of closely applied spindle cells surrounding a central mass consisting of a few endothelioid cells sometimes more or less obscured by hyaline degeneration. The nuclei of these central cells were round and granular, and the cell bodies, when distinguishable, were large, clear, and rounded when not closely pressed together. A feature of this growth was the separation of the cell structure into lobules by thin strands of

fibrous tissue apparently modified from the spindle cells. In these bands the blood vessels were usually found, showing more or less distinct fibrous walls. The larger vessels were found in the fibrous tissue, but blood channels were also found occasionally in the cell bands, in this situation having imperfectly developed walls. Some parts of the growth were unusually vascular for tumors of this class. This was especially noticeable along the line of junction with the dura. No perfectly walled blood vessels were found in any part of the growth, and none of any kind in the dense cell-whorls.

Hyaline transformation of the cell groups was not found to any extent. Very few hyaline globes, so commonly found in this class of tumors, were discovered in the present growth, though the central cells of some of the cell spherules were hard to stain and apparently becoming hyaline. A large tumor of the dura mater, exactly similar to this one in structure, was reported in the supplement to the report of 1894, illustrated in this work by Pl. IV and fig. 4, case 774.

The microscopic study of the kidneys showed advanced interstitial nephritis. Examination of the other organs was not deemed important.

#### CASE 76.

##### SPINDLE-CELLED SARCOMA OF BRAIN, PROBABLY ORIGINATING FROM THE DURA MATER.

G. C.; aged 73; soldier; nativity, Germany. Mental disease, chronic dementia, duration unknown. The symptoms in this case can not be given. The patient was profoundly demented, but no other symptom of intracranial growth was observed. The clinical history was not kept at the time and can not now be recalled, though from the situation of the growth very interesting effects must have been present.

The growth in all probability originated from the dura mater and penetrated the brain, carrying with it the pia mater. Subsequent examination of growths of similar character has convinced me that such is usually the case, though they are easily torn from their seat of origin, and may be mistaken for cerebral tumors with inflammatory adhesions to the dura mater.

Autopsy eleven hours after death. Body short, heavily built, and well nourished. Skin showed a yellowish tint.

*Cranium.*—Antero-posterior diameter of skull,  $6\frac{1}{4}$  inches; transverse,  $5\frac{1}{2}$  inches. Skull was thicker than usual and the dura mater was adherent to the bone.

Brain: Weight, 41 ounces (1,162.35 grams). Pia mater opaque and œdematous; pial veins full of blood; arteries not diseased. The convolutions were not flattened against the skull and there were no signs of increased intracranial tension, the atrophy of the brain being sufficient to permit the additional bulk of the tumor without general increase of pressure. A large tumor was found in the anterior portion of the left hemisphere of the brain. It encroached upon the posterior portion of the orbital convolutions, the anterior portion of the temporal lobe, the Island of Reil, and the basal ganglia and internal capsule. These structures were pressed aside and in part destroyed by the growth of the tumor and the olfactory and optic tracts were involved in the very center of the growth. The tumor was loosely connected with the surrounding substance, so that it was hard to keep it in place



during the dissection and subsequent hardening. It seemed to have originated from the dura mater, and shreds of the pia mater formed an imperfect capsule around the growth. The tumor was a dull grayish color, moderately soft and friable; the shape was nearly globular, and it was about 2 inches in its greatest diameter. Nothing unusual was noted in other parts of the brain, except some cedema and great reduction of consistence in the immediate vicinity of the tumor.

The other organs showed nothing of importance in relation to the intracranial growth.

#### MICROSCOPICAL EXAMINATION.

The microscope showed the tumor to be a spindle-celled sarcoma, in some respects peculiar in structure. The cells were small spindles with clear cell bodies, which stained faintly in carmine, and distinct, granular, elongated oval nuclei which stained with great brilliancy. The cells were arranged in closely packed bands and globular or oval whorls or cell nests, with one or more centers. The dense cell masses were intersected by bands of looser tissue, composed of spindle cells, delicate connective tissue, and blood vessels. Blood vessels, however, were found in all parts of the tumor. In the dense cell masses they were scanty and the walls were imperfect; in the looser tissue they were better developed; some were surrounded by several layers of spindle cells, and some had thick hyaline-looking walls in which the cells were hard to distinguish.

Scattered through the tumor were peculiar concentrically laminated, spheroidal or oval bodies of a glistening, hyaline appearance, which stained faintly in carmine. They contained one or more centers of lamination, around which the laminae were arranged, and often two or more of these centers became surrounded by a common capsule.

These hyaline bodies closely resemble the cell nests in size and arrangement, and they are supposed to be a hyaline transformation of the tightly packed cell masses. This belief is strengthened by finding nuclei, in every respect resembling those of the cells, in the center of some of the hyaline bodies, flattened and elongated nuclei between the laminae of some, and, finally, all intermediate stages between the cell nests and the hyaline globes."

NOTE.—This was the first tumor of the kind studied by the writer, and the case was reported in the supplement to the annual report of the hospital for 1892. The conclusions as to the nature of the hyaline spherules have been verified by numerous observations since that time.

#### CASE 715.

##### SPINDLE-CELLED SARCOMA OF FALX CEREBRI.

F. E.; aged 68; single; late soldier; nativity, Germany. This patient had none of the symptoms of intracranial tumor except dementia, and this was evidently not due to the presence of the tumor, as the growth was on the dura and there were no signs of pressure or other effect upon the brain except the depressions noted below. His mental disease was dementia, without marked delusions or hallucinations. The duration was about two years and eight months.

"An excellent description of a tumor, in every respect similar to this, will be found in an article entitled "Case of intracranial tumor," by Conolly Norman, F. R. C. S. L., *Journal of Mental Science*, July, 1890.



Autopsy five hours after death. Body fairly well nourished; large hydrocele of left side.

*Cranium.*—Antero-posterior diameter, 7 inches; transverse, 6 inches. Skull rather thinner than usual, peculiar in shape, and asymmetrical; sutures partly obliterated; small nodular exostosis at posterior end of sagittal suture. Dura mater moderately adherent to the bone. On the falx cerebri, about half an inch posterior to the coronal suture, was a small reddish-gray tumor about half an inch in diameter. It was situated on both sides of the falx, a little more on right side than on the left, and the falx seemed to pass directly through it. The growth was somewhat granular on the surface, and section showed the tissue to be of reddish-gray color and not very vascular. The superior longitudinal sinus passed through the tumor without any obstruction of its lumen, and the growth did not extend as far downward as the inferior sinus. Over the inner surface of the dura of left side was a thin, rust-colored false membrane of internal pachymeningitis; it extended to the base, but did not involve the basal portions.

Brain: Weight,  $38\frac{3}{4}$  ounces (1,098.56 grams). The pia mater adhered slightly to the surface of the tumor, so that the membrane was torn in removing the brain. The tumor had made a shallow depression on the median surface of the right first frontal convolution and the anterior portion of the paracentral lobule. The depression was slight and the cortex seemed normal within it. On the left side a corresponding depression could just be distinguished. The pia mater showed some opacity over the greater part of the convexity; veins moderately full of blood; arteries at the base atheromatous, distorted and irregular in caliber, and recently formed thrombi were found in all the principal vessels. The convolutions were greatly shrunken and indurated over the whole brain; the parts at the base were also atrophied, showing the crura and other structures with great distinctness. The ventricles were moderately dilated; the ependyma granular. Brain tissue rather firm; perivascular spaces enlarged; cortex very thin and yellowish in color.

*Thorax.*—Pleuritic adhesions on both sides. Right lung weighed 14 ounces (396.90 grams); the left, 20 ounces (567 grams). Some pleural scars at the apices and hypostasis of posterior portions of both.

Heart: Weight, 14 ounces (396.90 grams). Pericardial cavity obliterated by recent fibrinous adhesions. Pulmonary and tricuspid valves normal; aortic valves were greatly thickened and contracted, the segments just admitting the tip of the little finger; the contiguous edges of the segments were adherent and the attached edges were calcareous. The mitral valve was somewhat thickened at its free borders, but the orifice was normal; some calcareous deposits were found at the base of the valve. The left ventricle was somewhat dilated; the wall of the right was encroached upon by the superficial fat. The arch and thoracic portion of the aorta showed atheroma and dilatation almost amounting to a fusiform aneurism; the abdominal aorta was almost free from atheroma.

*Abdomen.*—Spleen: Weight, 4 ounces (113.40 grams); capsule, wrinkled; pulp, tough and fibrous.

Kidneys: Weight of the left with large cyst, 13 ounces (368.55 grams); with cyst emptied, 4 ounces (113.40 grams); weight of right, 4 ounces (113.40 grams). The left contained one very large cyst; the right a medium-sized cyst. Capsules adherent; surfaces smooth; cortex rather thin; pelvic fat abundant. Urinary bladder normal.

Liver: Weight 454 ounces (1,297.01 grams). Tissue showed slight passive congestion and some bile-staining; edges of left lobe somewhat thin and fibrous. Gall-bladder contained 2 ounces of bile and one calculus of medium size.

The other organs were normal to the naked eye.

#### MICROSCOPICAL EXAMINATION.

The tumor consists of slender spindle cells with oval or elongated nuclei and arranged in whorls or cell nests and bands running in every direction. These bands when cut transversely present the appearance of small groups of round cells with round nuclei. The whorls or cell-nests are round or oval. They are of all sizes, and occasionally two or more concentrically arranged cell-masses are surrounded by a common band of spindle cells. Bands of delicate connective tissue and spindle cells run through the growth, separating the tissue into groups or masses in some fields.

The blood vessels were not numerous; they have imperfectly developed walls, and are found in the dense, spindle-celled tissue, sometimes surrounded by several layers of spindle cells and sometimes running parallel with the spindle cells in the dense bands. Vessels are also found in the loose connective tissue between the cell groups. Portions of the included falx contain the preexisting vessels.

A peculiar feature of the tumor is the presence of great numbers of hyaline masses of all sizes, from bodies visible to the naked eye down to the size of an epithelial cell. The spheres of hyaline material are usually found in the centers of the dense cell-whorls, and are surrounded by several layers of unchanged spindle cells. The fact that *cylinders* of hyaline material are found in the centers of some of the dense bands shows that the hyaline masses must be the product of some kind of cell degeneration. The presence of cell-whorls in the transition stages of the hyaline change is additional proof of the nature of these bodies. Transverse and oblique sections of the hyaline cylinders resemble the spherules in every respect, but the direction of the surrounding cells enables us to distinguish between them. Occasionally a vessel is found with some hyaline degeneration of its walls. The diagnosis in this case is spindle-celled sarcoma of dura mater.

The examination of the brain shows advanced degeneration of the nerve-cells of the cortex. The vessels are curved and tortuous, and pigment is scattered along their walls. Other parts of the brain show the same general condition.

The microscope confirmed the diagnosis of the condition of the other organs.

#### CASE 1146.

#### SPINDLE-CELLED ENDOTHELIAL SARCOMA OF THE DURA MATER AND SOFT CARCINOMA OF THE STOMACH.

J. D.; aged 59; white; single; shoemaker; late soldier; nativity, New York; mental disease, chronic mania; duration, twelve years. No history of the patient previous to his admission to the hospital could be obtained. It was improbable that occupation or habits of life could have had any influence on the development of the tumors, though the condition of some of the organs may have been due to the abuse of

stimulants. The dural tumor was probably of long standing; the carcinoma was of uncertain duration. The tumor of the dura gave rise to no characteristic symptoms, and the presence of the cancer was only indicated by some gastric pain and occasional vomiting after eating. It is almost certain that the vomiting was due to the gastric tumor rather than that of the dura, as the latter was of small size and all other symptoms of intracranial growth were absent. The mental disease beginning with maniacal excitement gradually gave way to terminal dementia of a moderate degree, and for some time previous to his death the patient was employed at light work about the kitchen. He gradually failed, and died from exhaustion and inanition due to the condition of the stomach.

Autopsy eighteen hours after death: Body small, greatly emaciated, rigor mortis disappearing. Cranium: Antero-posterior diameter of skull,  $7\frac{3}{4}$  inches; transverse,  $5\frac{1}{4}$  inches. Shape, asymmetrical, the left side being the larger; sutures partly obliterated; bone of normal thickness. The outer surface of the skull bone was roughened and irregular in patches and showed a number of irregular depressions to which the pericranium adhered. In the occipital region some of these depressed areas yet remained soft and could be penetrated with the knife. The dura mater was adherent to the bone, but perhaps not abnormally so for a man of his age.

On the inner surface of the dura over the anterior part of the right third frontal convolution was a small globular tumor mass about three-fourths of an inch in diameter, firmly adherent to the dura mater and also attached to the pia, so that it could not be removed without tearing the latter. The tumor had made a slight depression in the convolution, but there was no loss of substance. The other portions of the dura seemed a little thickened, and a small nodule similar to the tumor described above was found on the inner surface over the left occipital region. This nodule had caused no depression in the brain. Section showed the tumor to be fibrous in structure, grayish-red color, firmly united with the dura and pia, but evidently derived from the former. The tissue was moderately firm, and slight grittiness was noticed on section.

Brain: Weight of each hemisphere, 21 ounces (595.35 grams); cerebellum, pons, and medulla,  $5\frac{1}{4}$  ounces (163 grams). The pia mater showed a moderate degree of vascular engorgement and some oedema, but no opacity or other alteration except as mentioned above. Arteries at the base not diseased. The brain tissue was very soft and oedematous and section showed enlargement of the perivascular spaces everywhere. The ventricles were moderately enlarged; ependyma smooth. Cerebellum, pons, and medulla were oedematous and soft; a small congested area was found in the right side of the pons, exposed by middle transverse section.

*Thorax.*—Limited chronic pleuritic adhesions on both sides, and a small quantity of fluid in each plural cavity.

Lungs: Weight of each,  $20\frac{1}{2}$  ounces (581 grams). Posterior portions of both lungs showed oedema and some hypostatic exudate in patches. Over the lower lobe of the left was a thin deposit of lymph.

Heart: Weight,  $6\frac{1}{4}$  ounces (191 grams). The superficial arteries were very tortuous and calcified; opaque patch over wall of right ventricle; valves of right side normal; aortic valves normal; mitral valve

a little thickened at its edges. Heart muscle brownish and superficial adipose tissue atrophied and edematous. Aorta atheromatous throughout.

*Abdomen.*—The abdominal cavity contained 112 ounces of straw-colored fluid. The appendix vermiformis was turned upward and backward and was adherent to the peritoneum.

Spleen: Weight, 7½ ounces (219 grams); capsule wrinkled and cartilaginous in patches; pulp, slate-colored, rather pale, and fibrous. Small supernumerary spleen near the hilus.

Kidneys: Weight of left, 4½ ounces (127.5 grams); right, 4 ounces (113.4 grams). The organs were somewhat indurated; capsules adherent; surfaces slightly granular; cortex rather thin; apices of pyramids whitened by urate deposits. Urinary bladder, normal.

Liver: Weight, 47½ ounces (1346.62 grams). The surface was slightly granular; edges somewhat rounded; upper surface of right lobe covered by a thin layer of apparently organized lymph, but it was not adherent to the diaphragm. The capsule showed some radiating scars over the superior surface; there was some general thickening of the capsule in the region of the gall bladder, and a large depressed scar was found in the under surface of the right lobe. The tissue was tough and leathery, and the cut surface was almost homogeneous in appearance, without any trace of lobulation, or bands of connective tissue, such as are usually seen in common cirrhosis of the liver.<sup>a</sup> The gall-bladder was normal.

Stomach: At the pyloric end of the stomach was a large fungoid growth, which bordered upon the pyloric orifice, but did not obstruct it to an appreciable degree. The growth was nearly two inches across in its greatest diameter and about three-fourths of an inch in average thickness. The surface was ulcerated and hemorrhagic; tissue was soft and juicy on section. The general surface of the stomach showed a granular condition and some opacity of the mucous membrane.

Intestines: No lesions were found in the intestines; mesenteric glands slightly enlarged but not cancerous.

Other abdominal organs were normal. No trace of secondary tumor deposits was found.

#### MICROSCOPICAL EXAMINATION.

Dural tumor: On superficial examination the tumor much resembled a hard fibroma, but on careful study it was found that the fibrous-looking tissue could be resolved into spindle cells with oval and elongated nuclei arranged in wavy bands, whorls, and concentrically arranged cell spherules, such as are commonly found in tumors of this class. The cell nuclei were very hard to stain and the cell bodies could not be distinguished when in masses. There was undoubtedly a considerable development of actual fibrous tissue and some hyaline change, which gave the tissue the peculiar appearance of a dense fibroma. The closely packed cell masses of various sizes were very numerous in some parts of the sections. In many of these the cellular structure could hardly be determined, owing to fibrous and hyaline change, and in some the degeneration had reached the stage of formation of the concentrically striated hyaline and calcareous spherules, such as shown in fig. 12. Besides these spherules, large irregular

<sup>a</sup>The condition of the bone of the skull and the peculiar variety of cirrhosis of the liver suggested syphilis, but as there was no proof of the existence of specific disease it was not mentioned in the history of the case.



areas of the same degenerative product were found in the large tissue masses where the cell structure was unusually dense. Blood vessels were not numerous, and those in the sarcomatous tissue had imperfect walls, though some fully developed vessels were found in masses of connective tissue, apparently derived from the dura. Hyaline change in the vessels was not marked.

The histogenesis of such tumors is certainly very obscure, but they are generally supposed to be derived from the endothelium of the brain membranes, and are therefore called endotheliomata by many pathologists. On account of the shape of the predominating type of cells, which are spindle-shaped and not endotheloid, I have named this and other like tumors spindle-celled endothelial sarcoma. The presence of the hyaline and calcified spherules being only accidental should not warrant the use of such terms as psammoma, acervuloma, etc., especially as the identity of these bodies with "brain sand" is not established.

Cancer of stomach: The cancer of the stomach was of the soft variety, and probably originated in the fundus cells of the pyloric glands. The cells were rather small, with prominent nuclei, and, where not influenced by mutual pressure, round. The growth was mainly in the mucosa, and no trace of gland-like tissue remained, except a tendency of some of the peripheral cells to arrange themselves in a single layer along the walls of the alveoli and to assume columnar shape by mutual pressure. The growth had penetrated very little into the muscular coats of the organ, but a few cancer cell-nests were found in the connective tissue trabeculae separating the muscular bundles of the circular layer. These cancerous masses were always surrounded by dense, small cell infiltration. The growth had not invaded any other organ or tissue.

Brain: The brain tissue was unfit for the more minute study of structure, on account of decomposition at the time of the autopsy. In ordinary sections the cells showed granular pigmentary degeneration; the pericellular spaces were large; the blood vessels had large perivascular spaces, but showed no disease of their walls. The cells of the spinal cord were granular and pigmented.

The lungs showed some exudation in the alveoli of the dependent portions. The kidneys showed a moderate increase of connective tissue in the vicinity of the glomeruli and between the tubules. The cells of the convoluted tubules were crumbled, and granular matter filled the lumen of the tubules.

The spleen showed enlargement of the venous sinuses and swelling and proliferation of the endothelium. The connective tissue was increased; the capsule much thickened, especially in the cartilaginous patches.

Liver: The microscopical appearances of the liver were very unusual. There was a moderate increase of the connective tissue between the lobules and in the portal canals. This tissue was richly nucleated in patches, and at the borders of these areas the tissue extended for some distance between the cell columns and the individual cells. There was no unusual proliferation of the bile ducts in the new connective tissue. In some places patches of new connective tissue were found among the cells, which were widely separated, misshapen, and atrophied. Occasionally isolated groups of leucocytes were found among the cells, without any relation to the connective-tissue areas. They were supposed to be centers of new growth.

In general, the liver cells were atrophied and the cell columns were widely septated by dilated capillaries. In some places this dilatation was excessive and had almost reached the angiomatous stage, the cells having completely disappeared. The diagnosis of the condition of the liver was difficult, but taken in connection with the naked-eye appearance, specific cirrhosis would certainly be suggested.

The mesenteric glands seemed to be merely hyperplastic, as no cancerous deposits were found in them. Other abdominal organs were not examined with the microscope.

#### CASE 1516.

##### SPINDLE CELLED ENDOTHELIAL SARCOMA OF THE DURA MATER PENETRATING THE BRAIN.

J. M.; aged 48; widower; late soldier; nativity, France. Mental disease, senile dementia; duration, unknown.

The symptoms in this case had probably no reference to the intracranial growth. It was small, pressed slightly upon the brain, produced no appreciable intracranial tension, and encroached upon no important structure. The patient was feeble and bedridden, but there was no paralysis. The mental symptoms were dementia with considerable minimal excitement, and much of the time he was apparently unconscious of his surroundings. Death seemed to be due to exhaustion from minimal excitement and general senile enfeeblement.

Autopsy seven hours after death. Body of average size; well developed; dependent parts of body livid. Direct inguinal hernia of right side.

*Cranium.* Skull thin and porous; shape, symmetrical; antero-posterior diameter, 14 inches; transverse, 5½ inches. Dura mater was adherent to the bone, and on the basal portion on the right side was a small tumor which pressed inward upon the brain at the entrance of the fissure of Sylvius. The growth had made but a slight depression in the brain and there was no appreciable increase of intracranial pressure. The growth had the usual appearance of dural tumors of this class; it was moderately hard, and firmly adherent to the dura. No adhesions to the brain were present and the cortex was apparently uninjured.

*Brain.* Weight, 1,200 grams. The convolutions were generally shrunken, atretic at the base atheromatous; ventricles enlarged; brain tissue soft and oedematous. No gross lesions were found in any part of brain. Left optic nerve atrophied, corresponding with loss of sight of the eye.

*Thorax.* Lung; emphysematous, pigmented, and contained a few fibrous nodule. Weight of the right lung, 400 grams; left, 300 gram.

*Heart.* Weight, 350 grams. The valves of right side were normal, except some increase of the size of the tricuspid orifice. The mitral was a little thickened at the margins; orifice normal; aortic valves calcareous at their attached margins and somewhat pouched. Aorta and coronary arteries atheromatous.

*Abdomen.* Spleen soft and dark; capsule thickened and wrinkled; weight, 100 grams.

*Kidneys.* Weight of right, 120 grams; left, 160 grams. The capsules were adherent; surfaces granular and cystic; cortex thin; pyramids

atrophied. Bladder hypertrophied and sacculated from obstruction of the urethra by enlargement of the prostate gland.

Liver: Weight, 950 grams. Organ rather small and somewhat congested.

Other organs showed nothing of importance.

#### MICROSCOPIC EXAMINATION.

The tumor proved to be a spindle-celled endothelial sarcoma. The structure consisted of spindle cells with oval and elongated nuclei and clear or faintly granular cell bodies, closely applied to each other, with no perceptible intercellular substance in the denser masses. In some parts of the growth the cells were more loosely arranged, and faint indications of fibrillated intercellular tissue could be seen. The cells were arranged in beautifully curved bands, running in every direction and in concentrically arranged cell spherules, which had frequently been changed to pearly hyaline bodies, so characteristic of this form of growth. Hyaline spherules of medium size were very common, and occasionally whole fields were found consisting of closely set cell spherules undergoing hyaline change, as shown in fig. 21. In addition to these hyaline cell nests, there were in some parts of the tumor numerous hyaline rods lying among the cells and often intermingled with each other and with the cells in an indescribable way. As a rule, these rods seemed to be found in bundles of cells running in the same direction, and were evidently due to hyaline transformation of cells, shown by the persistence of slender nuclei in the midst of the hyaline material. When cut transversely, these hyaline rods were seen to be cylindrical or rounded, and occasionally showed a central portion or core which stained deeply in hematoxylin, similar to the central portions of some of the hyaline spherules.

Blood vessels were not numerous, and were frequently represented by mere channels among the cells. Some showed a small quantity of fibrous tissue forming an adventitia, but connective tissue was scanty, and there was no appreciable division of the cell groups by vascular connective tissue, as in many tumors of this class.

Adhesions to the dura mater were found to be intimate, and the origin from this membrane was indicated by a gradual transition from the fibrous tissue of the dura to the spindle-cell structure of the tumor.

The brain was not examined with the microscope, as its condition had probably no relation to the tumor.

The kidneys showed advanced interstitial nephritis, and a small papilliferous cyst adenoma was found in one of the tissue blocks sectioned. Others may have existed, but were invisible to the naked eye, as was this one.

Other organs were not examined with the microscope.

#### CASE 965.

##### SPINDLE-CELLED SARCOMA OF DURA MATER.

C. S.; aged 77 years; married; farmer; late soldier; nativity, Germany. Mental disease, senile dementia; duration unknown. The history shows that the mental power failed gradually; hearing and vision were defective; there was general feebleness, but no distinct par-



There was a history of rheumatism, and he was known to have valvular disease of the heart. There were no characteristic symptoms of brain tumor, and those given above were attributed to his advanced age. Failure of the diseased heart was the immediate cause of death.

Autopsy fourteen hours after death. Body large and edematous; posterior portions of body, face, and neck discolored.

*Cranium.* Antero-posterior diameter of skull, 7 inches; transverse, 6 inches. Bone a little thicker than the average; sutures indistinct in both tables; posterior border of the sella turcica extended about one-eighth of an inch above its usual position. Dura mater adherent to the bone, but otherwise normal; no perceptible increase of intracranial tension; cerebro-spinal fluid increased.

Brain: Weight, 40 ounces (1,134 grams). On removal of the brain a tumor was found in the base, situated in the left temporal lobe adjoining the junction of the pons and crus, but not pressing upon either. The tumor had penetrated the brain through the middle of the gyrus occipito-temporalis medialis, pressing the brain substance aside and causing some absorption of the tissue in its advance. The growth was about 1½ inches in its longest diameter and had penetrated nearly an inch into the brain. The portion which had invaded the brain was rounded, but the exposed surface was flat and level with the basal surface of the brain, and had rested on the tentorium at its anterior angle. The surface on which the tumor rested was slightly roughened, but the fibers of the membrane could be seen running beneath without interruption, and it was difficult to believe that the growth originated from the membrane, as such tumors frequently do. Section through the middle of the growth showed the tissue to be dry, granular in appearance, reddish-gray in color, and minute gritty particles could be felt on the cut surface. The growth was sharply defined by an imperfect capsule and there was no infiltration of the brain tissue.

The convolutions were generally somewhat atrophied and separated by the edematous pia mater; there were no signs of pressure except locally around the tumor. At the base of the right occipital lobe was a small cortical softening. The arteries at the base were atheromatous in patches; the left vertebral was large and joined the basilar without change of caliber; the right was very small. Section of the brain showed edema and pallor of the brain tissue, but no other gross lesions. The cerebellum, pons, and medulla were in the same general condition as the cerebrum, and the cervical portion of the spinal cord removed with the brain seemed normal.

*Thorax.* Limited pleuritic adhesions on both sides. Lungs: Weight of left, 25 ounces (717.75 grams); right, 40½ ounces (1,155.26 grams). Over the anterior portion of the pleura of both lungs were small, thickened fibroid nodules; pulmonary tissue edematous; posterior portions engorged.

Heart: Weight, 20½ ounces (583.08 grams). Pericardial fluid increased; both layers of the pericardium were covered by opaque thickened patches, in some of which were flakes of calcareous deposit. The pulmonary valves were large and slightly thickened; tricuspid valve admitted four fingers and was thickened at its margins. Aortic valves were thickened, rigid with calcareous deposits, and roughened by vegetations along line of contact. The mitral valve was thick and contracted at its edges; orifice admitted three fingers. The chordæ

tendinæ were thicker than normal; summits of muscular papillæ fibrous; endocardium of left ventricle opaque. The heart walls were hypertrophied and the cavities all dilated. Section of the heart muscle revealed a number of small patches of interstitial myocarditis, especially in the wall of the left ventricle and the septum. The arch of the aorta was dilated; the intima showed slight fatty degeneration.

*Abdomen.*—The spleen weighed  $10\frac{1}{4}$  ounces (291.28 grams); capsule tense and a little thickened; pulp œdematous and soft.

Kidneys: Weight of left, 6 ounces (170.10 grams); right,  $5\frac{1}{2}$  ounces (155.92 grams). Capsules not adherent; surfaces faintly granular and showed a few depressions and small cysts. Cortex normal in thickness; pyramids rather pale. Urinary bladder normal.

Liver: Weight,  $59\frac{1}{4}$  ounces (1,693.91 grams). Surface faintly granular; capsule clouded in patches, and over the left lobe was a large fibrous patch, where it came in contact with the diaphragm beneath the pericardium. The tissue showed some passive congestion. Gall bladder normal.

The stomach showed a marked constriction about its middle, and the walls were thickened, thrown into large folds, and covered by tough mucus. Some small erosions and areas of congested vessels were revealed by the removal of the coating of mucus.

There were some old peritoneal adhesions in the vicinity of the ascending colon and gall-bladder. Other abdominal organs were normal.

#### MICROSCOPICAL EXAMINATION.

*Tumor:* The growth was extremely difficult to cut on account of its friability, and the edge of the knife was broken by the calcareous particles. The tissue consisted of irregular, wavy spindle cells arranged in concentric masses, and bands running in every direction, and a few round cells sometimes collected into small areas. The most striking feature of the structure was the presence of vast numbers of concentrically striated hyaline spherules of all sizes, with which the tissue was literally crowded. Some were as small as an epithelial cell, some were large enough to be distinguished with the naked eye. Some of the largest were composed of two or more globes fused together and surrounded by a common capsule consisting of the same hyaline laminated material. Fields were found in which the cells were nearly all crowded out by these hyaline bodies, and those yet remaining were frequently compressed between the closely set spherules. Many of the hyaline bodies were more or less calcified in their centers; such were apt to be displaced by the section knife, and often appeared partly turned over. In optical section the hyaline bodies appeared as disks, but when turned over and viewed in profile they appeared as segments of spherules made wherever the section knife happened to pass through them. In the majority of the hyaline globes of all sizes flattened elongated nuclei were seen between the laminæ; in some these nuclei were very numerous, suggesting strongly the appearance of the denser cell whorls found in such tumors.

Some of the hyaline bodies stained well in the nuclear stains, some stained faintly, and others not at all. Where calcified they were opaque and coarsely granular; when not they were clear and transparent. Their true chemical nature is not definitely determined, and the term hyaline, as applied to them, is used in its descriptive sense only.

That they represent some kind of degenerative change in the dense cell masses seems quite reasonable to the writer.

Very few blood vessels were found; those discovered seemed to run among the cells without definite direction relative to the cell structure. Very little connective tissue was found except at the periphery of the tumor and in the vicinity of some of the largest vessels.

The growth was regarded as essentially a spindle-celled sarcoma on account of the predominant cell elements, but it is probable that such tumors have been described as psammoma.

The brain tissue showed nothing of importance except the effects of oedema and some degeneration of the nerve cells.

The other organs were not examined with the microscope, as their condition seemed sufficiently clear to the unaided eye.

#### CASE 1503.

#### SPINDLE-CELLED ENDOTHELIAL SARCOMA OF DURA MATER PENETRATING THE BRAIN.

A. W., aged 66; married; laborer; colored; nativity, South Carolina. Mental disease, chronic epileptic dementia; duration, ten years. In this case there were no symptoms indicating tumor of brain except the dementia and the convulsions; the latter being distinctly epileptic led to the diagnosis of epilepsy, and the accompanying dementia was attributed to this disease. Headache was not complained of; vomiting was not observed, and though ophthalmoscopic examination was not made, there was no special affection of sight. The situation of the tumor invasion being in advance of all motor areas, paralyses were not to be expected. The exact relation of the the growth to the epilepsy and dementia is, of course, hard to determine, but it is reasonable to conclude that the penetration of the brain by the tumor might act as a traumatic cause of the convulsive seizures. The length of time the disease existed would agree well with the supposed slow growth of tumors of this class.

The immediate cause of death was cystitis and pyelo-nephritis, brought about by moderate but ball-valve-like enlargement of the middle lobe of the prostate gland.

Autopsy six hours after death. Muscular system well developed; body fairly well nourished; scar on left forearm.

*Cranium.*—Antero-posterior diameter of the skull, 7½ inches; transverse diameter, 5½ inches; skull of the usual thickness; shape symmetrical; sutures indistinct; dura mater adherent to the bone, but not abnormally so for the age of the patient.

Brain: Weight, 1,180 grams. There was no sign of intracranial tension, and the convolutions were moderately separated by oedema. A tumor of dural origin was found embedded in the brain at the lower and anterior part of the right frontal lobe. The growth had invaded the anterior portion of the third frontal convolution and the adjoining portion of the orbital convolutions. The tumor was about 1½ inches in its greatest diameter, and extended into the brain about an inch. It was firmly adherent to the dura mater and had penetrated the brain mechanically, carrying the pia mater and cortex in front of it, except at one place, where softening of the cortex had taken place. The growth was easily enucleated from the brain and was without capsule of  
rt, as was subsequently proven by the aid of the microscope.

The brain tissue in the vicinity was not appreciably softened, as is sometimes the case.

The growth was moderately firm in consistence, pale reddish gray in color, and on section it seemed gritty and friable. In the central portion the tissue was of a yellowish-white color and evidently calcified; the outer portion was grayish red in color and softer, apparently of more recent growth.

The brain substance was cedematous and somewhat soft. The arteries at the base were atheromatous, but there were no gross lesions in any part of the brain.

*Thorax.*—Left lung could not be removed on account of firm adhesions; right lung weighed 680 grams; the bronchi contained mucopurulent secretion, and the posterior portions were solidified by hypostatic pneumonia.

*Heart:* Weight, 380 grams. Valves of right side not diseased, except relative incompetency of the tricuspid valve. Aortic valves were somewhat thickened and calcareous; mitral valve slightly thickened at its free margins. The auricles were dilated; the left ventricle hypertrophied; superficial arteries tortuous and rigid; aorta corrugated and dilated at the arch, and at the lower part atheromatous and calcified in patches.

*Abdomen.*—The spleen weighed 220 grams, was enlarged, moderately firm, and congested.

*Kidneys:* Weight of each, 180 grams. The left was swollen, cedematous, and the cortex was streaked with blood and contained some small pus deposits. The right was in the same general condition, but no pus had yet formed. The pelves and ureters showed acute inflammation and contained muco-pus.

The bladder showed intense inflammation and the walls were ulcerated and in part covered by a dirty gray and hemorrhagic false membrane. The middle portion of the prostate gland was greatly enlarged and had acted as a valve-like obstruction to the urethral orifice. This prominent portion of the gland had been injured by the efforts at catheterization and was the seat of some hemorrhagic extravasation within.

The liver weighed 1,600 grams. Tissue was normal.

Other organs showed nothing of special importance.

#### MICROSCOPICAL EXAMINATION.

The tumor proved to be an endothelial sarcoma of the spindle-celled type, but with a marked tendency to preservation of the endothelial type of cells in the central portions of the cell masses, while those of the outer portions were spindle-shaped. The central cells when distinguishable were seen to be round and polygonal, with round nuclei; the outer cells had oval and elongated nuclei, and the individual cells were hard to distinguish except in very thin sections and when mechanically separated. A feature of the growth was the separation of the cell groups, large and small, by delicate bands of connective tissue apparently developed from spindle cells and containing slender elongated nuclei. The blood vessels were mainly found in this connective tissue, though a few small simple channels were found among the cells. The connective tissue strands and the contained blood vessels were evidently as essential a part of the growth as the cell groups themselves. If

growths as this the two unquestionably bear the same relation to each other as in ordinary alveolar sarcoma, both being neoplastic in origin. Hyaline degeneration was advanced in this growth, involving the cell groups of all shapes and sizes, the globular cell spherules, and the blood vessels. Some masses of hyaline change involved cell groups large enough to be seen with the naked eye. In these the arrangement of the cells could still be recognized by the remains of cells and flattened nuclei. In some of the hyaline masses occasional small blood vessels, still containing corpuscles, were found among the persistent cell nuclei. Many of the globular concentrically striated hyaline bodies were found in all parts of the growth. These we now believe represent a later stage of degeneration in spherical cell groups, though all traces of cells may be lost.

The blood vessels of all sizes showed advanced hyaline change. Some were nearly obliterated, showing on section an extremely small lumen containing a few blood cells. Transverse sections of completely degenerated vessels in which no lumen could be seen much resembled the small hyaline spherules. Longitudinal and oblique sections of degenerated vessels could usually be distinguished as such by the remains of the lumen containing red corpuscles. The hyaline substance into which the elements of the growth were transformed was perfectly homogeneous when complete change had occurred; but in most of the cell groups thus altered faint concentric or wavy lines indicated the grouping of the elements, and in the hyaline vessel walls extremely faint striations could usually be seen. (In the pen drawings fine stippling had to be used to represent the hyaline material, but in the sections it showed no granulations with medium powers.) In some parts of the tumor hyaline change had extended to nearly all the elements, and calcification had taken place in many of the masses. It is this later change which gives the gritty feel to the tissue and has caused the term "psammoma" to be improperly used for these tumors.

In fig. 24 I have given the general structure of the growth with hyaline cell groups and blood vessels. Fig. 25 shows some of the details under a higher amplification.

#### CASE 1582.

##### SPINDLE-CELLED SARCOMA OF THE DURA MATER.

D. K.; aged 81 years; male; white; soldier; nativity, Germany. Mental disease, senile dementia; duration, one year. The patient was quite feeble, being unable to move without assistance, and showed advanced dementia. His pulse was rapid; he had cardiac hypertrophy and valvular murmurs were present at mitral and tricuspid orifices. Examination of the urine showed albumen, casts, and some pus cells. He showed rapidly increasing muscular enfeeblement and became more stuporous until death occurred.

So far as could be learned there were no symptoms of intracranial tumor, and it is probable that being of slow growth and situated as it was in the outer and lower portion of the temporal lobe, no appreciable effects were produced. The dementia and even the muscular enfeeblement in a man of advanced years could scarcely be attributed to the presence of the tumor; and the stupor was probably in part due to the impairment of the kidneys, and in part to the compression of the brain from the coexisting hematoma.

Autopsy fourteen hours after death. Body small and somewhat emaciated; marked lividity of dependent portions.

*Cranium.*—Diameters of skull at line of section were  $7\frac{1}{2}$  by 6 inches. Calvaria rather thick; sutures distinct; shape symmetrical; dura mater firmly adherent to the bone. On both sides of the convexity and extending to the base was a thick false membrane of hemorrhagic internal pachymeningitis. Over the superior portions the neo-membrane was separated into two layers with a large effusion of blood between them. There was but little increase of dural tension and perhaps slight compression of the brain by the hematoma.

Brain: Weight, 1,240 grams. In the deepest portion of the left middle cerebral fossa was a large tumor which had originated from the dura mater and had penetrated the base of the temporal lobe. The growth had to be dissected from the surface of the dura mater in order to remove it with the brain, and the adherent dural surface was somewhat roughened and eroded, and the bone beneath was slightly irregular. The tumor was nearly circular in outline and hemispherical in shape, the outer or dural surface being flattened and adherent over the whole extent of the growth. It had the usual appearances of endothelial sarcomata of the dura; it was about an inch and a half in longest diameter, and had penetrated the brain to the depth of an inch. Partial enucleation of the tumor showed that the brain was penetrated mechanically by the growth and not by infiltration of its tissue. The tumor was reddish gray in color, and apparently more vascular than some tumors of the class. The left hemisphere was not incised at the time of examination; the right half showed no lesions of the interior. The convolutions were moderately shrunken; basal arteries showed a few patches of atheroma.

*Thorax.*—Limited pleuritic adhesions on both sides.

Lungs: Weight of right, 550 grams; left, 630 grams. The organs were oedematous throughout, showed some emphysema of the anterior margins and some hypostatic congestion of the posterior portions.

Heart: Weight, 350 grams. The tricuspid orifice showed some incompetency; the aortic valves were thickened and calcareous; the mitral valve was thickened, and had some old vegetations at the line of contact of the segments. At the apex of the left ventricle the muscle was mottled with patches of chronic myocarditis. The aorta showed slight atheroma of the arch.

*Abdomen.*—The spleen weighed 120 grams; capsule wrinkled and thickened in patches by cartilaginoid tissue. Pulp moderately soft.

Kidneys: Weight of each, 120 grams. Capsules were adherent; surfaces granular; cortical tissue a little pale and swollen; a few small cysts on the surfaces. Urinary bladder normal.

Liver: Weight, 1,200 grams. Tissue was apparently normal. Gall-bladder normal.

Stomach: Intestines and other abdominal organs showed nothing abnormal.

#### MICROSCOPICAL EXAMINATION.

The tumor proved to be a spindle-celled endothelial sarcoma, as indicated by the naked-eye appearances. The spindle cells were arranged in whorls and bands similar to many tumors of the class already described, and a small number of hyaline and partly calciferous spherules were found. Hyaline degeneration was a marked feature.

in this growth, affecting especially the blood-vessel walls and bands of connective tissue. The vessels were very numerous in some parts of the growth, and nearly all were hyaline and greatly thickened, though as a rule the lumen was preserved and filled with blood. Some of the vessels were surrounded by many layers of spindle cells, arranged circularly, and sometimes partly hyaline. In tumors of this class it is not uncommon to find blood vessels surrounded by a thick layer of concentrically arranged spindle cells, which may undergo hyaline degeneration and result in thick hyaline walls, such as are shown in fig. 28.

The connective tissue was relatively abundant in this growth, especially around the vessels. The mature fibrous tissue found in tumors of this class must be considered as an essential constituent, as it is in ordinary sarcomata and most other tumors. The exact histogenesis of the connective tissue in these tumors is hard to demonstrate, but it seems reasonable to conclude that it is of the same origin as the tumor cells, and its proliferation is due to the same causes.

Examination of the boundary between the tumor and the brain tissue showed what appeared to be remnants of the pia mater incorporated with the tumor, but still recognizable by the fully formed blood vessels and mature connective tissue.

The brain substance showed a border of degenerated tissue, but at a slight depth no alteration due to the presence of the tumor was perceptible.

General microscopic examination of the brain has not yet been made, and the histological study of the other organs was deemed unimportant.

#### CASE 1178.

##### SPINDLE-CELLED ENDOTHELIAL SARCOMA OF THE DURA MATER, PENETRATING THE BRAIN.

J. E.: aged 68; colored; widower; laborer; late soldier; mental disease, senile dementia; duration, three and one-half years. The patient was admitted to the Western Branch, National Home for Disabled Volunteer Soldiers, October 2, 1893, with left hemiplegia, convulsions, and was almost helpless. He was admitted to the insane ward April 27, 1897, with a history of advanced dementia, complete left hemiplegia, and general prostration.

On May 4, 1897, he was admitted to the Government Hospital for the Insane with the above mental and physical symptoms somewhat advanced. May 30, 1897 he died suddenly, apparently from an apoplectic seizure. From the recorded symptoms the tumor had apparently existed over three and one-half years.

Autopsy seventeen hours after death; body fairly well nourished; rigor mortis present; signs of commencing decomposition over lower part of abdomen.

*Cranium.* Antero-posterior diameter of skull,  $7\frac{1}{2}$  inches; transverse diameter,  $5\frac{1}{2}$  inches. The skull was rather thick and dense; shape asymmetrical, the occipital protuberance being situated to the left of the median line. Sutures visible externally, but indistinct in inner table. On the right side in the parietal region a marked elevation existed on the inner surface. There were no signs of external injury, and the elevation of the inner surface was probably related to the dural growth afterward described. Section of the bone through



this protuberance showed nothing abnormal but unusual vascularity of the tissue; both tables and the diploe were intact and the thickening seemed to be mainly of the cancellous tissue.

Brain: Weight of right hemisphere with the tumor, 19½ ounces (545.73 grams); left hemisphere 18 ounces (510.3 grams); cerebellum, pons, and medulla, 5½ ounces (155.92 grams). Before opening the dura mater a depression was observed in its outer surface in the parietal region corresponding with the elevation of the inner surface of the skull, and adhesions to the bone were firmer here than elsewhere. On lifting the dura from the brain a large tumor was found beneath it embedded in the brain, but apparently raised above its general surface by the dropping away of the soft and oedematous cerebral substance. The tumor was adherent to the dura, so that the membrane was left attached to it. The growth was 3½ inches broad in its antero-posterior diameter; 3¼ inches in its vertical diameter, and was exactly 1½ inches in thickness. The growth occupied almost the whole of the parietal lobe, had crowded forward the central convolutions and the fissure of Rolando, and the ascending parietal convolution was encroached upon and nearly destroyed by the pressure of the tumor. It extended vertically from the upper border of the posterior end of the fissure of Sylvius to the median edge of the hemisphere, and antero-posteriorly from near the fissure of Rolando to the anterior border of the occipital lobe. A section was made through the center of the growth, and it was then found that the tumor had penetrated the brain as far as the ependyma of the ventricles and nearly to the median surface of the hemisphere. On the median surface the tumor had not reached to the cortex, though probably pressure had destroyed brain function over the advancing growth. The quadrate lobe was greatly damaged and the paracentral lobule was practically destroyed.

The consistence of the tumor was quite firm, but the brain tissue surrounding it was soft and pulpy, so that the brain had to be handled with extreme care to avoid enucleation of the tumor while making the necessary sections. The growth had firm adhesions to the dura mater and it had apparently carried with it the pia mater as it penetrated the brain, and traces of membrane and even cortex could be distinguished around the boundaries.

The tumor tissue had a reddish-gray color; the surface looked a little granular, but no gritty particles could be seen or distinguished by cutting. Bands of connective tissue could be distinguished radiating from the origin of the growth and intersecting it in every direction.

The pia mater of the left hemisphere was cloudy over the convexity, and the convolutions showed the effects of pressure. There was some atrophy of the convolutions and oedema of the pia, but not as much as usual in cases of senile insanity due to other causes. The arteries at the base showed no signs of disease. There were no gross lesions in cerebellum, pons, and medulla. Cord showed no evidences of disease.

*Thorax.*—Pleuritic adhesion on both sides. The lungs were oedematous and full of blood posteriorly. Weight of the right, 22 ounces (623.7 grams); of the left, 20 ounces (567 grams). Some muco-purulent secretion poured from the bronchi on section.

Heart: Weight, 11½ ounces (326 grams). A thin band of connective tissue stretched across the entrance of the pulmonary artery, apparently a congenital malformation. The pulmonary valves were normal; the tricuspid valve was a little thickened at its edges. The aortic

valves were slightly thickened and had some small chronic vegetations at line of contact; mitral valve was slightly thickened at its edges. Aorta showed an early stage of atheroma; coronary vessels not diseased.

*Abdomen.*—The spleen weighed  $3\frac{1}{4}$  ounces (106.3 grams). Pulp firm; rather pale; capsule wrinkled.

Kidneys: Weight of right,  $4\frac{1}{4}$  ounces (120.48 grams); left, 4 ounces (113.4 grams). The capsules were not adherent; surfaces showed a few small cysts; in other respects the organs seemed normal. Urinary bladder was normal.

Liver: Weight,  $37\frac{1}{4}$  ounces (1,056 grams). Left lobe of liver very small; tissue seemed normal; gall-bladder contained 2 fluid ounces of bile.

The other abdominal organs seemed normal.

#### MICROSCOPICAL EXAMINATIONS.

Tumor of brain: The growth consisted mainly of delicate spindle cells with prominent oval nuclei and clear cell protoplasm. The cells were closely applied to each other in the dense cell masses, so that the contours of the cells were hard to distinguish, but were easily seen in the looser portions of the growth. The cells were arranged in wavy bands, running in every direction, and in concentrically grouped cell masses, though this was not a prominent feature in the growth. No hyaline cell groups were found in the sections examined, though they are probably formed in some part of the growth, as they are very common in growths of this class. Large bands of connective tissue intersected the tumor tissue in every direction. In some places this tissue was loose and fibrous and blended by various stages of tissue development into the spindle-cell tissue; in other regions the tissue was dense, almost devoid of nuclei and apparently hyaline. It seemed evident to the writer that this fibrous tissue was a development from the spindle-celled structure and as essential a part of the tumor as the cell tissue itself. The connective-tissue bands contained many large blood vessels, often with thick and hyaline walls, and many blood channels without definite walls other than a layer of endothelium separating the channel from the surrounding tissue. In some places these channels were very numerous, giving almost the appearance of angioma. Some of the vessels were completely obliterated by hyaline changes in all parts of the growth. In the cellular portion of the tissue blood vessels were not so numerous nor so large. Some of these were thick walled and hyaline, some were mere channels lined with flattened cells, and some were surrounded by many layers of spindle cells.

Brain: The brain cells were in an advanced stage of degeneration; in some cases clumps of brownish-yellow granules represented all that was left of the degenerated cells. The perivascular and pericellular spaces were very large; some of the blood vessels were curved, and hæmatoidin granules were found along their walls. The nerve cells of medulla, cord, and cerebellum were pigmented and granular.

The lungs were not examined with the microscope. The liver was normal except slight engorgement of the capillaries. The spleen showed the effects of chronic congestion in the enlargement and distinctness of the venous sinuses.

The kidneys were moderately full of blood; there was some crumbling of the inner portions of the cells of the convoluted tubules, and a few small cysts with colloid contents were found.

#### CASE 789.

##### SPINDLE-CELLED SARCOMA OF DURA MATER.

L. F.; aged 52; married; captain, U. S. Marine Corps; nativity, United States. Mental disease, chronic dementia; duration, one year and eight months. The patient had a certain degree of dementia when admitted, which deepened toward the close of life. He had hallucinations of hearing, taste, smell, and sight sensations were present, though he was totally blind. His prevailing mental tone was depression, though he was occasionally cheerful. He had some delusions of persecution, and was apprehensive of danger to himself; at times when influenced by these delusions he became irritable and abusive. Toward the end he became much demented, and finally he had a convulsive attack which terminated in coma and death.

The physical symptoms were not prominent; there seemed to be some impairment of muscular power on the left side; his speech was thick at times; there was some vertigo and occasional vomiting. Headache was not a prominent symptom, though occasionally he complained of pain.

Autopsy twelve hours after death. Body well nourished; rigor mortis present; lividity of the face, neck, and dependent portions of body.

*Cranium.*—Antero-posterior diameter of skull,  $7\frac{1}{2}$  inches; transverse, 6 inches. The skull was of the usual thickness, symmetrical and the sutures were normal. The dura mater was easily removed from the bone over the superior portions of the calvaria, but at the anterior extremity of the left middle cerebral fossa, over the right orbital plate of the frontal bone, and over the greater part of the right middle cerebral fossa, the membrane adhered firmly, and a considerable degree of roughening or absorption of the bone had taken place beneath it. On the right side of the crista galli an opening communicated with the ethmoidal cells, and on the right side of the frontal bone a similar opening communicated with the frontal sinus. Into these openings portions of softened cerebral substance had been forced, probably by intracranial pressure. The pia mater had been pressed in with the brain substance, and by its vessels kept the cerebral hernias alive. At the site of the dural adhesions the pia mater and brain cortex were firmly adherent to the inner surface of the dura, so that it was impossible to remove the brain without considerable laceration.

Brain: Weight of left hemisphere,  $28\frac{1}{2}$  ounces (817.97 grams); right hemisphere,  $27\frac{1}{2}$  ounces (779.62 grams); cerebellum, pons, and medulla,  $6\frac{1}{2}$  ounces (191.36 grams). The pia mater was oedematous; veins moderately full of blood; membrane adherent to the dura and cortex at points mentioned above. Arteries at the base normal in arrangement and free from disease. The convolutions were flattened against the skull, especially over the anterior portion of the right hemisphere. The orbital surface of the right frontal lobe was greatly softened, so that hernias of the brain had taken place through the openings in the dura and inner table of the skull. Over the whole adherent surface the brain cortex was torn by removal of the pia mater. The anterior extremity of the left temporal lobe was extensively softened, and cortex, pia, and dura were adherent together.

On the right side, at the entrance of the fissure of Sylvius was a large tumor nearly two inches in diameter which had probably originated in the dura mater, as it was firmly adherent to that membrane. It had penetrated the brain deeply, and had encroached upon and pressed aside the third frontal convolution, the lower portion of the ascending frontal, the anterior portions of the three temporal convolutions, and had invaded and pressed upon the island of Reil. The pressure had not appreciably affected the basal ganglia and capsules, as it was mainly in front of these structures.

The tumor was of a reddish-gray color, somewhat rough externally, and seemed to have a complete capsule. On section the growth presented about the same color. It was soft and seemed to be quite vascular. The sections showed that though the growth was adherent to the pia mater over the portions of brain it had invaded, the cortex was still distinguishable in advance of tumor, and even the pia mater could be seen between the tumor and the cortex. In the vicinity of the tumor the brain tissue was very soft, but no destruction of tissue had been caused by the invasion of the tumor.

The brain substance generally was soft, oedematous, and rather pale. There were no gross lesions of the interior of brain, cerebellum, pons, and medulla. The optic nerves and tracts were atrophied and gray in color. The right olfactory nerve had been destroyed by the softening in the vicinity. The other cranial nerves seemed normal to the naked eye. A portion of the cervical spinal cord removed with the brain seemed normal.

Other organs not examined.

#### MICROSCOPICAL EXAMINATION.

The tumor consists almost entirely of spindle cells in bands running in every direction, and some whorls, or concentric arrangements of the cells; but these are not so perfect as in some tumors of this class. The arrangement of the cells is much looser than in some similar tumors, and there is a considerable quantity of delicate connective tissue throughout the growth.

A striking feature in this tumor is the large number of huge vessels with thick fibrous walls which in the majority have undergone hyaline degeneration. Vessels with muscular tissue in their walls have not been found, though spindle-cell elements are certainly found in the walls among the fibrous tissue. In many of the vessels nearly the whole wall is converted into a hyaline, glassy material which stains lightly in carmine, and which I have supposed to be hyalin. Another peculiarity in these vessels is the cellular thickening of the inner coat, which much resembles the condition seen in endarteritis. A singular condition is seen in many of the large vessels which is not clearly understood by the writer. The endothelial lining is entirely separated from the vessel wall, and blood intervenes between the loosened endothelial cells and the vessel wall. As the sections were cut by the interstitial embedding methods and fixed to the slides before removing the infiltrating material, it must be concluded that such was the ante-mortem condition of the vessels.

A few large hyaline globes are found in the sections and great numbers of small hyaline, sometimes concentrically striated, round, or oval bodies are found in every part of the growth. They seem to be unusually numerous in the vicinity of the vessels, and they are often found

in close proximity to the hyaline material in the vessel walls. In some instances it seemed possible to resolve certain portions of the hyaline change in the vessel walls into these bodies. The similarity in appearance between the large hyaline globes and the small spherules suggests that they may be similar in nature and origin.

In this and in other descriptions of similar bodies the term hyaline is used as descriptive of the appearances rather than indicating any definite composition, for, though it is probable, it is not proven that they are the same in composition as the degeneration product, "hyalin," described by Recklinghausen. By the use of iodine and other staining agents, I am quite satisfied that the change in the vessels and the nature of the glassy bodies is not amyloid.

The brain generally shows little of interest. The tissue in the vicinity of the tumor shows some of the effects of pressure. The pericellular spaces are flattened and the cells are compressed. The nerve-cells show a moderate degree of yellow granular degeneration of the cell bodies, though the nuclei are always distinct. The blood vessels are somewhat tortuous; pigment, and sometimes a slight increase in the perivascular nuclei, may be seen.

The brain hernias are composed of mechanically disarranged brain tissue, with the products of softening and hemorrhage. The blood vessels carried in with the pia mater still retain their contents, and their walls show evidence of inflammatory changes. Some of the vessels in the brain hernias show glassy change in their walls. Many spider cells, large fatty epithelioid cells, and groups of round cells are found in different parts of the sections.

The cerebellum, pons, and medulla show nothing of special interest.

#### CASE 1130.

##### HEMORRHAGIC SPINDLE-CELLED SARCOMA OF THE CEREBELLUM AND MULTIPLE SOFT FIBROMATA OF THE SKIN.

A. B.; aged 61; white; single; laborer; late soldier; nativity, Pennsylvania. Mental disease, chronic epileptic mania; duration over four years. The patient was admitted to the Central Branch National Home for Disabled Volunteer Soldiers September 2, 1892. Medical history of chronic rheumatism, hemorrhoids, and epileptic seizures. He had fits of violence at intervals of four or five days, in which he tried to injure his attendants, break furniture, etc. Mental power weak when admitted to the Soldiers' Home.

On admission to the Government Hospital for the Insane, May 4, 1893, he was weak; was soon confined to his bed; moderately demented; memory, perceptions, and comparative faculty all impaired, but he could talk rationally, for the most part. He had no delusions, but showed progressive dementia, with occasional attacks of impulsive fury, in which he would beat his bed and attack anyone coming within his sight or reach, at the same time uttering inarticulate cries of rage. These furors were of brief duration, and were followed by short periods of confusion, with rapid breathing from excitement and exertion, to pass into the usual state of quiet dementia.

The whole body was covered by soft fibrous tumors of the skin, varying in size from the smallest visible nodule to the size of a walnut. In certain regions the skin hung in pendulous masses of the

same character as the tumors. His general health was fair, aside from weakness, and there was no evidence of organic disease other than of the brain and the dermal growths. He had no paralysis nor altered sensations other than impairment of acuteness, though the mental dullness of the patient made the physical examination difficult.

The patellar reflex was somewhat exaggerated. There was no appreciable affection of the cranial nerves; no headache; no neuralgic pain; sight was not appreciably affected. He had occasional attacks of vomiting, and suffered from vertigo on assuming the erect posture.

No convulsion occurred for more than a year after his transference to the Toner Building, August 14, 1894, except the psychical attacks of rage and violence. In the summer of 1896 the first epileptic convulsion occurred, after which the psychic attacks were completely superseded by those of distinct epileptic character. Dementia progressed rapidly during the last few months of his life, and death occurred suddenly November 13, 1896.

The progressive impairment of the cerebral functions and the degree of physical and mental failure suggested organic disease of the brain, but otherwise there were no symptoms to differentiate the case from one of chronic epilepsy.

Autopsy six hours after death: Rigor mortis not developed. The whole body was covered with soft fibrous growths of the skin, which varied in size from an inch in diameter to a pin-head size. Some of the growths were pedunculated; all were very soft; some were a little darker than the surrounding skin, and some the same color. The forehead was thickly studded with the growths, and they were especially numerous on the arms. Over the right gluteal region, outer and lower portion of right thigh, and outer aspect of right leg below the knee, the skin seemed to hang in large masses, which appeared to be of the same character as the tumors. On the right leg, just below the knee, was a somewhat more tumor-like mass nearly 3 inches in diameter. The large pendulous masses are of the same nature as the circumscribed growths, but are less sharply defined from the normal skin. By some pathologists they are regarded as continuous outgrowths, closely allied to elephantiasis; by others they are believed to be diffuse hypertrophies of the skin. They are frequently associated with soft fibromata of the skin, and must be regarded as due to the same cause.

Section of the tumors showed them to be very soft and succulent, somewhat less fibrous than the dermis and a little less elastic, so that the tumor tissue projected from the cut surface as the skin retracted. In hardening, the skin over the tumors became greatly wrinkled and shrank away from the tumor mass, and the whole growth was greatly reduced in size.

*Cranium.*—Antero-posterior diameter of skull, 7½ inches; transverse, 6 inches. Skull a little thicker than the average; shape symmetrical; sutures rather indistinct. On the outer surface were a number of small nodular exostoses slightly raised from the surface of the bone. The dura mater was not abnormally adherent to the bone, except over a small area in the anterior part of the left cerebellar fossa, where it was also adherent to a tumor which was embedded in the left hemisphere of the cerebellum. The general surface of the dura at this situation was smooth, and there were no indications of growth having originated from the dura mater.



*Brain.*—Weight of right hemisphere, 23½ ounces (666.2 grams); left hemisphere, 23¼ ounces (673.3 grams); cerebellum, pons, and medulla with the tumor, 8 ounces (226.8 grams). The subdural space was dry and there was a marked degree of intracranial pressure indicated by flattening of the convolutions against the dura over the whole convexity. Embedded in the outer anterior part of the left cerebellar hemisphere was a hemorrhagic tumor about an inch and a half in its long diameter and an inch and a quarter in transverse diameter. The growth was irregularly oval in shape, with its long axis parallel with the horizontal plane of the cerebellum. Incision into the growth showed the greater part of the mass to be blood clot, the remainder of the tumor tissue of moderately firm consistence. Though the blood had coagulated into a firm clot, it did not appear to be of long standing, as no degenerative changes had taken place in the blood. A firm capsule had retained the extravasation, and the hemorrhage did not appear to have added much to the size of the growth. It was therefore supposed to consist for the most part of infiltrated tissue, and such the microscope proved it to be. The fifth nerve was stretched over the superior surface of the tumor, showing that it started at the extreme lower and anterior portion of the cerebellum. The pons was displaced toward the right, and the growth encroached upon the seventh and eighth nerves at the upper part of the medulla. Where the growth was embedded in the cerebellum it had caused loss of substance and some softening, as may be seen in the photographs.

The vessels at the base of the brain were not diseased; ventricles greatly dilated; brain substance cedematous and soft; perivascular spaces enlarged; no gross lesions in any part of cerebrum, except some induration of the hippocampi and uncinata gyri.

The cerebellum, pons, and medulla were preserved intact as a museum specimen, and therefore were not examined by section.

*Thorax.*—Some bands of chronic pleuritic adhesions were found on the right side. At the apices were some old pleural scars and some small grayish nodules, supposed to be tubercular deposits. Large hemorrhagic areas were scattered throughout the other portions of the lungs. The left lung weighed 19 ounces (538.6 grams); the right, 24 ounces (680.4 grams).

Heart: Weight, 12 ounces (340.2 grams). Pulmonary valves normal; tricuspid a little thickened; aortic valves were a little thickened and showed some adhesion to each other at their attached edges. Mitral valve slightly thickened at its edges. Heart muscle firm; aorta normal.

*Abdomen.*—The spleen weighed 12¼ ounces (347.2 grams); capsule wrinkled; pulp very dark, full of blood, and soft.

Kidneys: Weight of right, 4½ ounces (120.4 grams); left, 4¾ ounces (134.6 grams). The organs contained more blood than normal; capsules slightly adherent; surfaces showed some depressions and were a little granular; cortex was somewhat reduced in thickness. The urinary bladder showed some hypertrophy and enlargement of the middle lobe of the prostate gland.

Liver: Weight, 48½ ounces (1,375.9 grams). The tissue showed slight, passive congestion. Gall-bladder contained a small quantity of dark bile.

The other abdominal organs were apparently free from disease.



## MICROSCOPICAL EXAMINATION.

**Tumor of brain:** The greater portion of the bulk of the tumor was composed of blood and tissue so infiltrated with blood that it was impossible to make sections of it. The greater part of the tissue which remained outside the hemorrhagic area was composed of spindle cells in close proximity to each other arranged in wavy or curved bands running in every direction. The spindle cells were delicate and closely applied to each other, so that it was difficult to see the cells except in very thin sections and where accidentally torn apart, and the direction and arrangement of the cells was mainly indicated by the nuclei. Some fields were found in which round cells predominated, lying among delicate connective tissue fibrils. These fields were found most frequently near the seat of hemorrhage, and it is possible that many of the round cells were leucocytes. In the midst of masses of spindle-celled tissue groups of round nuclei were often found; these were supposed to be transverse sections of the nuclei of spindle cells. In the purely cellular portion of the growth no connective tissue was visible, but in certain fields the process of fibrillation was far advanced, and in some of the round-cell areas the intercellular substance was distinctly fibrillated. Some areas were found in which the structure resembled the early stages of granulation tissue, and indeed there may have been some reactive inflammatory tissue formation. The structure of the growth was in fact very confusing, and diagnosis was only made by examination of large areas composed exclusively of spindle cells. The blood vessels in the cellular tissue were of the type found in all sarcomata: they had imperfect walls composed of flattened cells, and ran as mere channels through the tissue; in a few, however, hyaline change had thickened the walls and even obliterated the lumen. In the fibrous tissue some of the vessels had thick fibrous or hyaline walls and some were mere channels in the tissue lined with flattened cells. No vessels with perfectly developed walls were found in any of the tumors of this class, and, in fact, it seems that perfect vessels are not developed in the low grade of connective tissue found in these neoplastic structures. Large blood-channels lined with flattened cells were found in the tissue adjoining the hemorrhagic portion of the growth. The tumor undoubtedly belongs to the same class as those of cases 1146 and 1178, though the whorl-like arrangement of the cells was not so perfect and no hyaline cell spherules were found. Though the structure of the growth was somewhat perplexing and the origin uncertain, it was diagnosed a spindle-celled endothelial sarcoma, probably of the membranes of the cerebellum.

**The soft fibromata of the skin:** These tumors presented the usual appearances of such growths. They consisted of delicately fibrillated connective tissue richly nucleated with small, elongated, or rod-like nuclei, frequently curved or twisted. In all parts of the sections brightly stained round nuclei were seen, which were transversely cut sections of the rod-like form. In certain places groups of round nuclei were found, probably centers of growth. In some parts of the sections nuclei of both forms were very numerous, giving the tissue a general resemblance to spindle-celled sarcoma; but careful examination would show that in the fibroma the nuclei are among the fibers and not within spindle cells, and that in the fibrous tumor the tissue is more mature and dense than in fibro-sarcoma. For comparison with the

brain tumor I have drawn two fields from the fibromata—one showing a richly nucleated field, the other the more typical appearance of the growth.

The blood vessels in the denser and older portions of the tumors were not numerous, and many presented the appearance of mere channels in the tissue lined with endothelium. In the more cellular part of the tissue many new-formed blood vessels were found in all stages, from capillaries to fully developed arteries and veins. On the borders of the tumors adjoining the true skin the deeper parts of coil glands, sebaceous glands, and deep-hair follicles were included in the new tissue. Peripheral nerve trunks were found occasionally within the tumor tissue, and though there was undoubtedly some increase of the connective tissue of the nerves, especially of the epineurium, there was no other evidence of connective tissue of the nerves entering into the formation of the growths.

Brain: The pia mater was thickened; the blood vessels of the brain were tortuous and lay in wide perivascular spaces with much altered blood pigment around them. The nerve cells were granular and excessively pigmented; perivascular and pericellular spaces enlarged. The cerebellum, pons, and medulla were not examined.

Lungs: The sections from the apices showed chronic tubercular deposits in the alveolar walls and around the bronchi. The tubercular nodules were surrounded by dense masses of round cells in which were many blood vessels. The central portions of the nodules were composed of epithelioid cells of various sizes and shapes apparently in the early stages of tissue formation. No vessels were found in the central cell masses, but degeneration had not taken place on account of the vascular supply to the peripheral parts of the nodule. Very few giant cells were found. Some of the alveoli were narrowed by thickening of their walls and contained a few epithelial cells. In the hemorrhagic areas the alveoli contained blood and the vessels were engorged.

Spleen: The capsule was thick, the trabeculae prominent. The pulp showed great engorgement, large areas contained nothing but blood.

Liver: The tissues showed nothing abnormal except slight passive congestion and some pigmentation of the cells.

Kidneys: There was a slight increase of the connective tissue, mainly around the glomeruli. The tissue contained more blood than usual; the tubules were slightly dilated; the epithelium granular and somewhat disintegrated at the inner margins, and the tubules contained granular matter probably derived from the cells.

The other organs were not examined with the microscope, but were apparently normal.

#### CASE 833.

ENDOTHELIAL SARCOMA OF DURA MATER, ADENOID CANCER OF STOMACH,  
AND ROUND-CELLED SARCOMA OF TESTICLE.

J. D.; aged 80; single; late soldier; nativity, United States; mental disease, senile dementia; duration, over six years. In this case there were no symptoms of brain tumor. The patient was much demented, deaf, and very feeble physically, but he had no definite paralysis. The case possesses unusual interest on account of the existence of three tumors of different kinds, two of which are malignant and the other at least semimalignant.

Autopsy twelve hours after death. Body emaciated and cachectic; right testicle enlarged and indurated.

*Cranium.* Antero-posterior diameter of skull,  $7\frac{1}{2}$  inches; transverse,  $5\frac{1}{4}$  inches. Skull very thick and dense; the greatest thickness was in the frontal and occipital regions; skull asymmetrical, the right side being the larger, and the occipital protuberance was very prominent and was situated to the left of the median line. The forehead was very receding; sutures partly obliterated in external table and not distinguishable in the inner table; Paccchionian depressions large and deep.

The dura mater was somewhat adherent to the bone; on the left side a strong membrane of internal pachymeningitis covered the convexity of the dura and extended downward over the anterior and part of the middle cerebral fossae; the right side of the dura was somewhat thickened but otherwise normal. In the anterior portion of the left middle cerebral fossa was a small tumor, firmly attached to the dura mater by a somewhat constricted base. The tumor was about an inch and a quarter in its longest diameter; it was irregularly globular in shape, and the surface was granular or finely nodular. The tumor encroached slightly upon the anterior extremity of the temporal lobe and had made a small depression therein. Where the growth came in contact with the brain the pia mater and cortex were adherent to the surface of the tumor, and the cortex was destroyed over an area about three-fourths of an inch in diameter.

On removing the tumor with the dura mater the bone was found to be somewhat absorbed beneath the growth. There was no appearance of intracranial tension, and whatever symptoms may have been produced by the tumor must have been local.

Brain: Weight of each hemisphere,  $17\frac{1}{2}$  ounces (496.12 grams); cerebellum, pons, and medulla,  $5\frac{1}{2}$  ounces (155.92 grams). The pia mater showed marked edema and some opacity over the superior portions of the convexity and the upper portion of the median surfaces. The whole brain was much atrophied, but the greatest shrinkage was over the superior portion of the convexity. The arteries at the base were very calcareous and much distorted; the posterior communicating arteries were large and furnished the main blood supply to the posterior cerebral region, as the vertebral system of arteries was very ill developed. The brain substance was very soft and edematous; cortex pale and yellowish in color; white matter dark or clay colored; some of the minute arteries of the brain were calcareous. The ventricles were dilated; the ependyma smooth; no gross lesions in the interior of the brain. The left temporal lobe showed a softened area corresponding to the contact with the dural tumor, as above mentioned. The softened area was not large, but the cortex over it was softened and destroyed, and the white matter was slightly invaded. Cerebellum, pons, and medulla showed no gross lesions.

*Thorax.* Firm pleuritic adhesions on both sides.

Lungs: Weight of right, 35 ounces (992.25 grams); left,  $26\frac{3}{4}$  ounces (758.36 grams). The left lung showed great thickening of the pleura, in some places at least half an inch in thickness. The lungs both showed chronic bronchial inflammation and inhalation of the products of the same into the air vesicles of the posterior portions of the lungs. The right lung showed a considerable degree of solidification.

Heart: Weight,  $9\frac{1}{2}$  ounces (276.41 grams). Valves of right side normal; aortic valves a little thickened; edges of mitral valve slightly thickened. The coronary arteries were rigid tubes, on account of calcareous degeneration. The aorta was very atheromatous and calcareous, especially at its lower part. Heart walls showed nothing of importance; cavities were full of coagulated blood.

*Abdomen.*—The spleen weighed 7 ounces (198.45 grams); organ very soft, almost diffuent; splenic artery very calcareous.

Kidneys: Weight of each,  $4\frac{1}{2}$  ounces (127.57 grams). Capsules adherent; surfaces irregular and granular; cortex thin. In the left were several large cysts, and in each were a number of whitish nodules, some about half an inch in diameter, which were afterwards found to be secondary deposits of round-celled sarcoma. The urinary bladder showed some hypertrophy, and some enlargement of the middle lobe of the prostate gland.

Liver: Weight,  $53\frac{1}{2}$  ounces (1,523.81 grams). Capsule of right lobe was thickened over the convexity; tissue normal. Gall-bladder contained an ounce of normal bile.

Stomach: At the pyloric end of the organ were four small polypoid growths, and at the cardiac end was a large cancerous ulceration which extended to the opening of the œsophagus but not beyond it, and was about 2 inches in diameter. The edges of the ulceration were thickened, and near the edges were polypoid protuberances and several small nodules resembling those at the pyloric end. The mucous membrane over the remainder of the organ was mammillated and covered with thick tough mucus.

The duodenum and other parts of the intestinal tract were apparently normal.

The pancreas was indurated and nodular; pancreatic artery very calcareous.

A large group of lymphatic glands which were situated around the cœliac axis and the superior mesenteric artery were found to be greatly increased in size, soft, juicy, and were apparently confluent, so that individual glands could only be seen around the periphery of the mass. Enlarged glands could be traced downward along the great vessels, and several slightly affected nodes were found on the spermatic cord. The right testicle was at least ten times as large as the normal, and weighed about 7 ounces. Incision showed that the proper tissue of the gland was replaced by a soft, juicy, pinkish-white growth almost exactly like that of the mass of enlarged abdominal glands described above. The cavity of the tunica vaginalis was partly obliterated by adhesions, but contained a few drachms of clear fluid. The other testicle was normal.

#### MICROSCOPICAL EXAMINATION.

The main bulk of the brain tumor in this case is made up of slender spindle cells with oval and elongated nuclei, arranged in loose bands and whorls. The cells are sometimes closely packed, but as a rule the tissue is loosely intermingled with a small amount of delicate fibrous tissue, in which the principal blood vessels are found. In some fields the cells are nearly all arranged in the form of whorls or cell-nests, and in the centers of these "nests" are a few endothelioid cells with clear distinct cell bodies and conspicuous nuclei. A few of the small whorls are hyaline in their centers, so that individual cells can not be distin-

Autopsy twelve hours after death—  
right testicle enlarged and indurated.

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Autopsy four hours after death. Body emaciated; signs of old skin lesions on the legs, probably scurvy; superficial veins prominent everywhere; dependent portions of body livid; skin yellowish everywhere. The left tibia showed indications of a badly united fracture; scar an inch and a half long on left side of forehead.

*Cranium.*—On the left side of the frontal bone was a depression about 2 inches in length and half an inch in width, corresponding with the scar mentioned above. The inner surface, at the site of the depression, was slightly raised, as if the inner table had been fractured at the time of the injury, but the signs of fracture had disappeared. The skull was rather dense, diploë scanty; shape, symmetrical; antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse,  $5\frac{1}{4}$  inches.

The dura mater adhered firmly to the bone, and over the whole inner surface was a thin rust-colored false membrane. On the right side of the convexity, over the parietal lobe, a small tumor projected from the inner surface of the membrane. The tumor was about three-eighths of an inch in diameter; projected about three-sixteenths of an inch from the surface of the dura. The growth was granular on its surface; it was firmly seated on the membrane, and section showed it to be of a grayish-red color and very vascular. The growth was too small to make any depression in the brain, and it could not have produced any symptoms. It was, however, of some histological interest, and for this was carefully studied with the microscope.

Brain: Weight of right half,  $20\frac{1}{2}$  ounces (581 grams); left half, 21 ounces (595 grams). The pia mater showed patches of opacity over the convexity and opaque lines along the principal veins. The arteries at the base were atheromatous and calcareous, and were irregularly dilated, looped, and curved. On the right side the posterior communicating artery was larger than normal, and the left was represented by small branches distributed to the crus, and did not join the posterior cerebral artery as usual.

The convolutions were greatly shrunken everywhere, and the parts of the base were atrophied. A small cortical softening was found in the right superior temporal convolution. The brain tissue was very œdematous, the perivascular spaces were enlarged, and the consistence of the brain substance was reduced. The ventricles were dilated; the ependyma was smooth. Nothing abnormal was noted in the cerebellum, pons, medulla, and in the cervical portion of the cord removed with the brain.

*Thorax.*—The right pleural cavity contained 36 ounces of fluid. The left side contained the normal quantity. Lungs: Weight of right,  $16\frac{1}{2}$  ounces (467.77 grams); left,  $18\frac{1}{2}$  ounces (524.47 grams). The left lung was slightly adherent, showed some emphysema of anterior margins, and the bronchi showed evidences of chronic bronchitis. The right lung showed chronic thickening of the pleura, circumscribed adhesions, emphysema, chronic bronchial inflammation, and the lower lobe and a portion of the middle lobe were collapsed and of a gray slate color.

Heart: The pericardial fluid was slightly increased; heart distended with fluid blood. Pulmonary valves normal; tricuspid valve slightly thickened at its free margins, and the orifice admitted five fingers side by side. The aortic valves were slightly thickened, some elevations were seen along the line of contact, and there were some calcareous patches between the layers of the valves. The mitral valve was much



thickened, its chordæ tendinæ shortened and thickened, and the apices of the muscular papillæ were fibrous. The valve had some small chronic vegetations along the line of contact. The auricles were greatly dilated. Both ventricles showed slight hypertrophy and some dilatation. The weight when emptied of blood was  $15\frac{1}{2}$  ounces (439.42 grams).

*Abdomen.*—Spleen: Weight,  $6\frac{1}{2}$  ounces (177.18 grams). Capsule thickened in patches; pulp firmer than normal.

Kidneys: Weight of right, 5 ounces (141.75 grams); left,  $6\frac{1}{2}$  ounces (191.36 grams). The right kidney was movable and was situated below and to the left of its normal position. The shape of the organ was abnormal, the hilus was directed forward, and the artery entered the substance of the organ outside the hilus. The left kidney was in its normal position; the capsule was adherent; surface granular; cortex thin, irregular on the surface, and a number of cysts showed on the removal of the capsule. The pyramids were somewhat atrophied and the pelvic fat was increased. The right kidney was less altered by disease than the left. The urinary bladder was normal, except some hypertrophy of the middle lobe of the prostate gland.

Liver: Weight,  $53\frac{1}{2}$  ounces (1,516.72 grams). The surface was granular, borders irregular, and a few yellowish-white patches of small size were seen on the surface. On incision the cut surface showed the typical appearances of common cirrhosis. The gall ducts throughout the organ were dilated and at the lower end of the common duct a large impacted calculus was found. The cystic bile duct and the bladder were dilated and the latter contained pale, watery bile and thirteen small calculi.

The pancreas, stomach, and intestines seemed normal.

#### MICROSCOPICAL EXAMINATION.

The tumor consists of spindle cells, large endothelioid cells arranged in groups, numerous blood vessels, and some connective tissue. The cells are somewhat difficult to describe; many spindle cells are found everywhere in the sections, arranged in bands, around the vessels, and in the connective tissue. Transition shapes between the large endothelioid cells and the spindle cells are seen in certain places in the sections. The endothelioid cells are rather more important constituents of the growth than the spindle cells. They are found in large groups, separated in places by open linear spaces which divide the cells into irregular masses and rows which much resemble columns of liver cells. No explanation of this peculiar arrangement was arrived at.

The groups of endothelioid cells are separated more or less perfectly by loose bands of spindle cells with some connective tissue running with them, and by areas containing many large blood vessels with layers of spindle cells around them.

The blood vessels constitute a very important part of the tumor; they are very large and numerous and uniformly filled with blood. Their walls are made up of an endothelial coat reinforced by a variable amount of connective tissue and spindle cells. Sometimes many layers of spindle cells are seen around a vessel, and sometimes the wall seems to be mainly fibrous tissue. I have not found any muscular fibers in the vessel walls.

The vessels are mainly in the loose connective tissue between the groups, though a few are found in the fasciculi of spindle cells;



none are found in the dense masses of endothelioid cells. The vessels are of course of new formation, though their mode of origin is not clearly established.

The diagnosis is endothelial sarcoma, originating probably in the endothelium of the lymph spaces of the dura mater, or from the cells of its inner lining.

The brain cells show advanced degenerative changes; the cell bodies are granular and yellow and many are disintegrated at their margins. The vessels are tortuous, and a few hemorrhages, and much pigment is found in the perivascular spaces. The cerebellum, pons, and medulla show some vascular changes and some cell degeneration.

The liver shows the microscopical appearances of common cirrhosis.

The kidneys show some increase of the intertubular tissue. Other organs not examined.

#### CASE 278.

##### SPINDLE-CELLED SARCOMA OF THE DURA MATER.

W. F.; aged 67; chiropodist; nativity, United States; mental disease, senile dementia; duration over one year. In this case the tumor was small and had produced no symptoms. Owing to the atrophy of the brain, no depression had been made in the surface. The cause of death was probably atheromatous softenings of the brain.

Autopsy twenty-four hours after death. Body well nourished.

*Cranium.*—Antero-posterior diameter of the skull,  $7\frac{1}{8}$  inches; transverse,  $5\frac{3}{8}$  inches. Skull bone normal. Dura mater unusually adherent to the bone along the borders of the superior longitudinal sinus. A small tumor was found on the inner surface of the dura over the posterior portion of the right superior frontal convolution. No depression was made in the cortex, as the tumor was small and did not project over one-fourth of an inch from the surface of the dura.

Brain: Weight, 42 ounces (1,190.70 grams). The pia mater over the left temporal lobe was adherent to the dura over a region corresponding to a large softening involving almost the whole lobe. Another large softened area involved the lower part of the left occipital lobe. The large softenings extended through the white matter to the ependyma of the ventricles and several small areas were found in the basal ganglia. On the right side no softenings were found, but the general consistence was reduced. The arteries were very atheromatous, in some places nearly obstructed. The other organs showed nothing of importance.

##### MICROSCOPICAL EXAMINATION.

The microscope showed the growth to be a spindle-celled endothelial sarcoma of the dura mater, in structure quite similar to that in case 76. The predominating types of cells were spindle-shaped with oval nuclei and sharply attenuated ends and small groups of round endothelioid cells which had not yet assumed the spindle form. On transverse section the spindle cells appeared as small rounded elements with scanty protoplasm lying among the longitudinal bands. The transverse sections were extremely hard to differentiate into individual cells, and the spindles could be recognized mainly by the shape and direction of the nuclei. The cell masses in general showed slight tendency to form concentrically arranged groups and only a few hyaline spherules of small size were found.

Irregular delicate bands of connective tissue intersected the cell structure. These usually carried the largest blood vessels, often with thick fibrous walls; smaller vessels with sometimes fibrous walls and sometimes as mere endothelial channels were found among the cells.

The brain tissue showed no effects which could be attributed to the tumor, and the microscopic examination of other organs was not considered important.

## SERIES II. GLIOMATA.

Five of the tumors studied were gliomata originating in the brain substance. Of these, three were much degenerated, but in parts the tissue was sufficiently preserved for diagnosis. The tumor represented by fig. 53, case 820, should probably be classed with the gliomas, but on account of its cellular structure it has been put down as glio-sarcoma, and will be described later on.

The gliomata are tumors originating from the glia, or supporting tissue of the central nervous system, and possibly in some nervous structures elsewhere. The glia cells and fibrils are now believed to be of ectodermic origin, and therefore must be closely related both to the nerve cells and the surface epithelium. This view makes it clear how we may have the varieties of the growth such as ganglionic, ependymal, astrocytic, and fibrillary gliomata. All of the writer's cases were of the astrocyte type, though commonly presenting great variety and complexity of structure. In all gliomata the essential structure is composed of cells of ectodermic origin and fibrils supposed to be derived from them, though in some tumors the fibrillated structure seems to be distinct from the cell elements, and it may be differentially stained. In ordinary staining, and especially if the tissue has not been well preserved, it is extremely difficult to determine the origin and nature of the fibrillary intercellular substance.

In addition to the ectodermic elements, the gliomata are richly supplied with blood vessels and their accompanying fibrous tissue, both of mesodermic origin. On this account there seems to be good reason for regarding the gliomata as compound tissue tumors, indeed closely allied to the carcinomata in histogenesis. It must be also remembered that glioma is closely related to the several forms of gliosis, and to embryonic errors of development.

In view of the recent observations as to the histogenesis of the neuroglia, the presence of an unusual number of round cells, if known to be of mesodermic origin, would warrant the continued use of the term glio sarcoma, used for a combination tumor, and not as a designation for a variety of sarcoma or a transition form of growth.

In the descriptions of some of the gliomata studied some time ago the views as to the origin and nature of the neuroglia then held were accepted. It has not been considered as essential to change this, as the exact relation of the elements of the supporting and nutrient tissues of the nervous system is not yet settled.

In the drawings from these growths fields showing the general structure were selected, though in all great variations of structure were found in different parts, necessitating in some cases several drawings from the same tumor.

An interesting feature in one case was the presence of a small field of cancer-like alveoli containing cells indistinguishable from those of ordinary cancer. The presence of epithelial cells in a tumor of ecto-

dermic origin would not be remarkable, but the origin of these cells was not determined. (See fig. 48, and note to case 1426.)

The gliomata have been illustrated by four plates and eleven drawings, showing the structure as it appears under ordinary amplifications and some of the developmental and degenerative modifications of the gliomatous tissue.

#### CASE 601.

##### GLIOMA OF THE RIGHT FRONTAL LOBE.

J. S.; aged 42; single; soldier; nativity, United States. Mental disease, dementia; duration, seven months. The symptoms in this case were characteristic of brain tumor, the dementia was well advanced, and there was marked paralysis of left arm and leg.

Autopsy twenty-six hours after death. Body well nourished; bed sores over sacrum and both trochanters.

*Cranium.*—Antero-posterior diameter of skull, 7 $\frac{1}{2}$  inches; transverse, 6 $\frac{1}{2}$  inches; skull thin; sutures indistinct; shape slightly asymmetrical. Dura mater somewhat adherent to the bone and unusually tense over the right side. On reflecting the dura slight inflammatory adhesions to the pia mater and cortex were noted anterior to the upper end of the fissure of Rolando, the site of the brain tumor to be described.

Brain: Weight, 48 ounces (1,360.80 grams). The right hemisphere was considerably enlarged anteriorly and pressed toward the left, so that the falx had made a deep impression on the median surface. The convolutions were flattened over the right frontal lobe, the surface was dry, and the superficial vessels were congested over the situation of the tumor.

Incision showed a large growth situated in the brain at the posterior ends of the right first and second frontal convolutions. It was globular in shape, about 2 $\frac{1}{2}$  inches in average diameter, and apparently had developed in the white matter, the cortex not being involved, except by the inflammatory congestion and adhesions above noted. Section showed that the growth extended into the white matter of the first frontal convolution, paracentral lobule, second frontal, and ascending frontal convolutions, and had pressed backward upon the central fissure and flattened the ascending parietal gyrus.

The tumor was quite soft, reddish gray in color, vascular, and the boundaries were very distinct. The white matter in the immediate vicinity of the tumor was appreciably indurated; the cortex over it was softened and reddened. A small cyst was situated beneath the tumor, between it and the roof of the ventricle; it was separated from both by a layer of white matter. The cyst contained clear watery fluid and was apparently independent of either tumor or ventricle.

The tumor, on account of its gross appearances, was thought to be some form of sarcoma, but subsequent microscopical examination showed the structure of unusually vascular glioma. Other portions of the brain showed no gross lesions and there were no secondary deposits.

*Thorax.*—Chronic pleuritic adhesions on both sides.

Lungs: Weight of right, 25 $\frac{1}{2}$  ounces (731.92 grams); left, 20 ounces (567 grams). Extensive gangrene of right lung, with somewhat less involvement of the left.

Heart: Weight, 11 $\frac{1}{4}$  ounces (318.93 grams). Slight chronic disease of mitral valve.

*Abdomen.* Spleen: Weight, 6½ ounces (191.36 grams). Pulp dark and soft.

Kidneys: Weight of, 6½ ounces (184.72 grams); right, 4½ ounces (121.57 grams). Some engorgement of the surface veins and slight swelling of the cortex.

Liver: Weight, 48½ ounces (1,374.97 grams). Slight passive congestion and some bile-staining of the tissue.

Other organs were apparently normal.

#### MICROSCOPICAL EXAMINATION.

The tumor was found to be a glioma of very complex structure. The cells were multiform, but many were spindle-shaped and round like those of sarcoma. The round cells were mainly small, and were most numerous in the vicinity of the blood vessels, some of which were surrounded by dense groups of these cells.

The spindle cells were found mainly in bands running in every direction, and astrocytes and large round cells lay in groups among them. Some fields seemed to be made up of large, irregularly shaped, spindle cells, large and small round cells, and scanty granular intercellular substance. Such tissue could readily be mistaken for polymorphous-celled sarcoma. The intercellular matrix in general appeared granular, with a few fine fibers, processes of astrocytes, and spindle cells, giving it a faintly striated appearance in some places.

The blood vessels were large and numerous in all parts of the growth. They had thin, undeveloped walls, and commonly were accompanied by a little fibrous adventitial tissue. Occasionally vessels with fully developed walls were found, probably preexisting cerebral arteries and veins, such growths being alterations of the tissue rather than substitutions.

The peculiar grouping of the glia cells in the vicinity of some of the vessels, such as shown in fig. 46, case 1053, was sometimes observed in this tumor.

To assign tumors such as this to their proper class is, of course, very difficult, but careful examination of the most characteristic parts confirmed the diagnosis of glioma, probably primarily of the astrocytic type. The possible and even probable correlative increase of the mesoblastic elements must be borne in mind, and to call such growths gliosarcomata, in the sense of combination tumors, would not be improper.

The brain tissue around the tumor showed some evidences of irritative overgrowth of the glia cells, the cortex was congested, and the nerve cells were granular and crumbled. Other organs showed no important histological changes.

#### CASE 832.

##### GLIOMA OF LEFT TEMPORAL LOBE.

A. E.; aged 72; widower; late soldier; nativity, United States. Mental disease, chronic epileptic dementia, duration unknown. The history previous to his admission to this hospital is very indefinite. He was demented when admitted, and had been melancholy and threatened suicide at the Soldiers' Home. While in the hospital he was always feeble and confined to bed. Three weeks before his death he

had a severe convulsion, with coma, lasting eighteen hours. He suffered from severe pain in the lumbar spine, which was aggravated by moving him, and he had partial paralysis of legs. Four days before his death he had an attack of partial coma, with apparent paralysis of right arm and leg and some impairment of reflex action; the mouth was drawn to the left side; swallowing was difficult; the pupils were normal in size, but moved slowly. The general paralytic condition continued to increase until death occurred.

Autopsy seventeen hours after death. Body well nourished; bed sores over sacrum.

*Cranium.*—Antero-posterior diameter,  $7\frac{1}{2}$  inches; transverse,  $5\frac{1}{2}$  inches. Skull of the usual thickness; diploë abundant and congested; inner surface of frontal bone somewhat nodular; sutures partly obliterated; arterial depressions large and deep. Dura mater not unusually adherent to the bone; falx fenestrated in frontal portion, and the adhesions to the pia mater along the edges of the median surfaces were firmer than normal.

Brain: Weight of right hemisphere,  $23\frac{1}{2}$  ounces (673.31 grams); left hemisphere, 27 ounces (765.45 grams); cerebellum and brain stem,  $6\frac{1}{2}$  ounces (191.36 grams). The convolutions of the left hemisphere were flattened against the skull at the parietal and temporal regions. Upper portions of subdural space dry. Brain cortex unusually dark in color. A large, soft, hemorrhagic, and gelatinoid growth occupied the lower and posterior portion of the left temporal lobe. It was posterior to a line drawn through the retro-central fissure and parallel with it. The growth occupied almost the whole of the white matter of the temporal lobe, extending from the ventricle almost to the cortical substance of the convex surface. The tumor did not actually reach the surface of the brain, though a branch of the posterior cerebral artery seemed to owe its firm adhesions to the pia mater to the proximity of the tumor.

The growth was extremely soft, degenerated, and hemorrhagic. The exact boundaries could not be determined, as the growth seemed to gradually merge into the brain tissue around. The growth presented a grayish, gelatinoid appearance, with some pigmentation of the tissues and hemorrhage. The brain tissue generally was very soft, oedematous, and the perivascular spaces were enlarged greatly, especially in the lower and anterior portions of the frontal lobes. No gross lesions were found in other parts of the brain. Arteries at the base showed patches of opacity; posterior communicating arteries enlarged, and furnished the main blood supply to the posterior cerebral region.

The ventricles were slightly enlarged, and in the left was found a soft, yellow clot, which was supposed to be coagulated serum, caused by admixture of a small quantity of blood which had oozed from the ventricular surface of the tumor.

The cerebellum, pons, and medulla showed no gross lesions. The cortex of the cerebellum was very dark.

*Thorax.*—No pleuritic adhesions. Weight of right lung, 28 ounces (793.80 grams); left lung, 24 ounces (680.40 grams). Lungs oedematous and the posterior portions hypostatic; signs of chronic bronchitis.

Heart: Weight,  $12\frac{1}{2}$  ounces (361.46 grams). Some opacity of pericardium over the right auricle and ventricle; valves of right side normal; aortic valves thickened and calcareous; mitral valve thickened, contracted, and calcareous. Heart muscle flabby and relaxed;

some dilatation of all the cavities. **Aorta atheromatous** and calcareous at its lower portion.

**Abdomen.** Spleen weighed  $2\frac{1}{2}$  ounces (70.87 grams); pulp fibrous and pale.

**Kidneys:** Weight of left,  $5\frac{1}{4}$  ounces (163.01 grams); right,  $5\frac{1}{2}$  ounces (155.92 grams). Capsules easily removed; surfaces irregular and somewhat granular; a few cysts in the cortex of each; pyramids slightly atrophied; pelvic fat abundant. The urinary bladder showed slight inflammation and contained some turbid urine.

**Liver:** Weight,  $5\frac{3}{4}$  ounces (1,516.72 grams). Tissue a little bile-stained; gall-bladder normal.

Other abdominal organs normal.

#### MICROSCOPICAL EXAMINATION.

The examination of the tumor growth was very difficult on account of the degenerative changes, hemorrhages, and coagulations in the various parts of the growth. By disregarding all the accidental conditions and examining the most solid portions of the growth the diagnosis was made of glioma.

The cells of the tumor proper are of almost every conceivable shape, and they vary almost as greatly in size. Branched, spindle, round, oval, and almost every imaginable shape of cells are found in the most typical fields without any definite arrangement. Some of the larger cells have distinct nuclei and cell bodies, but many of the small forms show no trace of protoplasm around the apparently naked nuclei. Some fields show the cell forms, such as are represented in fig. 43, some are composed of short spindle cells, some are made up of round cells intermingled with spindle forms, and some fields show nothing but round cells of small size. The ground substance is in some fields relatively abundant; in some regions it is scanty. It is coarsely granular, and shows a few coarse fibers in some regions. It much resembles the supporting tissue of the gray matter of the brain. Large areas show nothing but granular material, the result of degeneration, while other regions are made up of red and white blood cells and fibrin.

In some parts of the tumor blood vessels are very numerous, and are large, tortuous, and looped. They sometimes have very thick fibrous walls, which are partly converted into hyaline material. Frequently large areas of coarse cellular tissue, consisting of cells resembling the tumor elements, and loose fibrous tissue are seen to surround one or more vessels, making a kind of island in midst of fields of cells. The cells and fibrous tissue in these vascular islands are often well preserved and distinct, while the surrounding cellular tissue is much degenerated. Vessels with a small quantity of fibrous tissue are also found in the midst of the fields of tumor cells.

In the vicinity of the tumor limits the brain tissue shows spider cells and swollen neuroglia nuclei; but these elements do not seem to enter directly into the tumor growth.

The nerve cells in the brain generally show granular pigmentary degeneration; the pericellular spaces are greatly enlarged. The vessels show some distortion and a marked increase of nuclei in their perivascular spaces, especially in the vicinity of the tumor. The nerve cells of cerebellum, medulla, and spinal cord show slight granular degeneration.

The kidney sections show some increase of fibrous tissue.



## CASE 1053.

## GLIOMA OF THE BRAIN.

J. B.; aged 75; widower; painter; late soldier; nativity, United States. Mental disease, senile dementia; duration uncertain.

The patient was considerably demented when he was admitted, so that any close study of the subjective symptoms was impossible. He showed none of the characteristic symptoms of intracranial growth except the dementia, and tumor of the brain was not suspected.

Autopsy four hours after death. Body well nourished for the age of the patient; rigor mortis present in muscles of head and neck.

*Cranium.*—Skull slightly thicker than usual; sutures partly obliterated in inner table; the depressions for the middle meningeal artery large; Pacchionian depressions normal; dura mater generally a little thickened and adherent to the bone. Cerebro-spinal fluid somewhat increased.

Brain: Weight of right hemisphere,  $21\frac{1}{2}$  ounces (609.52 grams); left,  $19\frac{1}{2}$  ounces (552.82 grams); cerebellum, pons, and medulla,  $5\frac{1}{4}$  ounces (163.01 grams). On removing the dura mater from the convexity a slight increase of intracranial tension was observed over the frontal lobes, especially the lower portions; vessels of the pia mater moderately full of blood. Convolutions generally somewhat atrophied over the convexity. On separating the frontal lobes a tumor mass was found in the anterior portion of the corpus callosum and adjoining portions of the hemispheres. Section showed that the growth had enlarged the genu of the corpus callosum to about twice its normal thickness, and had extended laterally into the frontal lobes, ending indefinitely in the white matter. The greater portion of the growth was in the right hemisphere, but the exact size could not be determined, as the tumor tissue gradually ended in the surrounding brain substance. The tumor tissue seemed to involve the greater portion of the white substance of the right frontal lobe anterior to the ventricle, and to a less degree the left frontal lobe was invaded. The growth had just visibly encroached upon the lateral ventricles, but had not extended backward beyond the anterior portion of the ventricular cavities. Examination of the interior showed the tumor to be soft, friable, and grayish-white in color, somewhat mottled with hemorrhagic areas. The brain tissue in the vicinity of the tumor was very soft, yellowish, disintegrated, and some of the serum which filled the loose meshes of the broken-down brain substance had coagulated into soft, yellow clots. The convolutions of the median surfaces over the growth showed swelling and oedema, so that the arteries were deeply embedded in the surface and the two median surfaces were flattened against each other by mutual pressure. The brain substance generally was soft and oedematous, and both white and gray matter had a faint pinkish tinge. No other gross lesions were found in any part of the brain. Cervical spinal cord removed with the brain seemed normal.

*Thorax.*—Chronic pleuritic adhesions on right side; left side free. Weight of left lung, 18 ounces (510.30 grams); right lung,  $24\frac{1}{4}$  ounces (694.57). Anterior portions of both were slightly emphysematous; posterior portions of both lungs were hypostatic, partly solidified by a slimy exudate, and over the surface of the affected portion of the

right were some subpleural ecchymoses and a layer of fibrinous exudate.

**Heart:** Weight, 13½ ounces (382.72 grams). Superficial arteries were opaque in patches and their walls were tortuous. Pulmonary valves normal; tricuspid valve slightly thickened at its edges and its orifice admitted four fingers; the aortic valves were slightly thickened and showed some old vegetations and calcareous deposits; mitral valve thickened at its edges and somewhat contracted. The auricles were moderately dilated, and the right ventricle showed some hypertrophy. Arch of the aorta slightly dilated and atheromatous.

**Abdomen.**—The spleen weighed 1¼ ounces (49.61 grams); capsule wrinkled; pulp tough and fibrous.

**Kidneys:** Weight of each, 4¼ ounces (120.48 grams); capsules slightly adherent to cortex; surface faintly granular and showed a few small cysts; both pyramids and cortical substance somewhat atrophied. The urinary bladder was slightly hypertrophied and there was some enlargement of the middle lobe of the prostate.

**Liver:** Weight, 50 ounces (1,417.50 grams). The tissue showed slight passive congestion; upper surface of right lobe was opaque in patches. Gall-bladder contained about an ounce of thick black bile.

**Intestines:** The large bowel contained hard masses of fæces; small intestine normal; other abdominal organs were normal.

#### MICROSCOPICAL EXAMINATION.

**Tumor and brain tissue:** The arteries within the tumor were enormously thickened; the veins to a less degree. In most cases the vessel walls seemed to consist mainly of fibrous tissue with a few nuclei, but some appeared to have been converted into hyaline material; some of the arteries were totally obliterated by the growth of fibrous tissue. The vessels as a rule were filled with blood; some contained thrombi. There were many areas of hemorrhage and coagulated fibrin among the cells. The tumor tissue itself was very difficult to study. It seemed to consist of a dense mesh-work of rather coarse fibers running in every direction, and in the meshes of this fibrous tissue lay the cellular elements. The cells were of every conceivable shape, but the majority seemed to be stellate or branched; there were also small round cells, large round cells, pyriform, spindle, and other shapes without apparent branches. On careful examination it seemed that much of the fibrous intercellular substance was made up of the branches of the stellate cells, but this could not be determined in the hardened tissue. In some fields the tissue was very dense, and the cells were of uniform size and seemed to be nearly all branched cells of various shapes; in other fields the cell elements were much larger, of unequal size, and of every possible shape; in other areas where the tissue seemed very loose and degenerated the most of the cells were very large, round, and granular, much resembling the large granular cells found in the vicinity of cerebral abscesses. Fields showing these varieties of cells have been carefully drawn by the aid of the camera lucida, and are introduced to facilitate description (figs. 44 and 45).

The tumor tissue was found to extend far into the brain substance, and the cell elements gradually became smaller and resembled more and more the ordinary branched neuroglia cells. These cells were very numerous in the brain substance in the vicinity of

the tissue,

but were conspicuous by their size and numbers throughout the frontal lobes. This relation between the growth of the neuroglia cells and the development of the tumor shows clearly that we have under consideration a neoplasm derived from the neuroglia, a glioma. The naked-eye appearances and other characteristics of the growth agree with this diagnosis. The gliomata vary greatly in their histological details; some are richly cellular and approach the sarcomata in structure; others consist to great extent of fibrous tissue and are nearer the fibromata; but this one is undoubtedly a true glioma derived from the branched neuroglia cells.

A curious feature was sometimes observed in the more degenerated portions of the growth. A vessel would be seen surrounded by a dense cluster of the glioma cells of every size and shape, suggesting the grouping of spider cells in the vicinity of blood vessels in general paralysis and other conditions of neuroglia proliferation. The thickening of the blood-vessel walls was probably due to the same cause as the connective-tissue overgrowth which produced the tumor, as the small vessels elsewhere were normal (fig. 46).

The tissue of other parts of the brain showed some increase in the size and number of the neuroglia cells, but no secondary tumor deposits. The nerve cells were in various stages of granular degeneration throughout the brain. The cerebellum, pons, and medulla showed nothing remarkable. The spinal cord seemed normal.

The other organs showed nothing of importance in addition to the naked-eye diagnosis.

#### CASE 1426.

##### GLIOMA OF BRAIN INVOLVING THE LEFT FRONTAL LOBE.

W. C. G.; age, 45; male; widower; sailor; nativity, Pennsylvania; mental disease, chronic dementia from tumor of the brain.

In this case the dementia was too extreme to obtain subjective symptoms. He had many of the objective signs of organic disease of brain, but tumor was not diagnosticated. The usual symptoms of brain tumor observed were paralysis of the right side extending to the tongue and pharynx, convulsive seizures, and the extreme dementia. Delusions, if present, were obscured by the mental failure. Death occurred in a convulsive attack of epileptiform character.

Autopsy eight hours after death. Body fairly well nourished; some lividity of dependent parts of body, head, and neck.

*Cranium.*—Skull symmetrical; antero-posterior diameter, 7 inches; transverse, 5½ inches. The dura mater was not adherent to the bone; the membrane was tightly stretched over the brain, and the subdural space was dry and the surfaces were sticky; no adhesions to the brain were noted.

Brain: Weight of right hemisphere, 540 grams; left hemisphere, 640 grams; cerebellum, pons, and medulla, 160 grams. The convolutions were greatly flattened against the dura mater, especially over the left side, and the left frontal portion was pressed over against the falx, making a deep impression of the latter against the median surface. Examination showed a large growth situated in the left frontal lobe, evident by increase of the size of this part and by enlargement of the small pial vessels over it, though it was situated beneath the cortex and had the same feel as the normal brain on palpation. Incision

showed a large, soft, grayish-red tumor mass in the frontal lobe anterior to the line of the precentral fissure. Both central convolutions were strongly pressed backward, the middle and inferior frontal convolutions were pressed downward and outward, and the first frontal was almost destroyed by the encroachment of the growth.

Incision of the tumor about the middle showed that the growth was probably a glioma or glio-sarcoma, originating from the brain itself; it had no definite boundaries, seeming to end gradually in the normal brain surrounding it. The central portions were considerably degenerated and cystic, the peripheral parts more firm and redder from greater vascularity. No portion of the new growth seemed to actually reach the pia mater, though the cortex of part of the first frontal convolution was extremely thin. The growth reached the roof of the lateral ventricle and extended slightly into the corpus callosum. The extreme diameters of the growth were probably 2 inches antero-posteriorly and about 1½ inches in transverse diameter. In the vicinity of the tumor the brain tissue was, as is usually the case, abnormally soft; in other parts the brain substance was oedematous, but no gross lesions were found. The arteries were normal to the unaided eye.

*Thorax.*—Lungs were oedematous and congested; bronchi filled with frothy mucopurulent secretion. Weight of right, 490 grams; left, 550 grams.

Heart: Weight, 340 grams. Valves of right side normal except some enlargement of the tricuspid orifice. The left valves were not diseased, but the mitral orifice was slightly enlarged; aorta normal.

*Abdomen.*—The spleen weighed 390 grams; capsule adherent to surrounding parts; parenchyma soft and dark.

Kidneys: Weight of right, 160 grams; left, 140 grams. Some adhesion of the capsules, and the surfaces were granular and contained a few cysts. The cortex was about the usual thickness. The urinary bladder was normal.

Liver: Weight, 194 grams. The organ contained a little more blood than usual, but was otherwise normal. The gall-bladder contained a large number of calculi.

Stomach and intestines normal.

#### MICROSCOPICAL EXAMINATION.

The tumor was found to be made up of cells of almost every conceivable size and shape, lying in a matrix apparently composed of delicate fibrils. The predominating kind of cells was the branched, or asteroid elements which are usual in tumors of this type. They varied greatly in size and shape and in the character and number of their branches. Some showed clear homogeneous cell bodies and some were faintly granular; nuclei were sometimes present, sometimes the cells were so cut that the nuclei were not seen; occasionally cells with several nuclei were found. Where the tissue was dense the shape of the cells seemed to be somewhat influenced by mutual pressure, but in the looser parts of the growth finely branched cells were common, and many large, round, clear, epithelioid cells were found. Small lymphoid cells or nuclei, which stained deeper than the glia cells, were found in great numbers everywhere, sometimes collected in large groups especially in the vicinity of blood vessels.

The fibrillated matrix seemed to be made up, ~~at least~~ in part, of the branches of the gliomatous cells, though it was ~~that fibrous~~

tissue was also present. This was especially evident in the vicinity of the blood vessels, and the vessels themselves often showed thick walls composed of nucleated fibrous tissue, apparently continuous with loose fibrous tissue in the vicinity. Numerous blood vessels of large size were found in all parts of the growth; they were uniformly filled with blood cells and sometimes contained groups of leucocytes. Some blood channels of rather large size showed very imperfectly developed walls; in none of the vessels could muscle cells be demonstrated in the walls.

A peculiar feature was found in one of the tissue blocks sectioned. A small area was found containing groups of cells of epithelial type, arranged in alveoli, exactly resembling cancer. No other cell groups of this kind were found, nor was there any tendency toward this arrangement in any other part of the growth. In fig. 48 I have represented this structure at the right-hand side of the drawing. This structure is seen to be separated from the true gliomatous tissue on the left by a band of somewhat more condensed and fibrous tissue, and the alveolar walls are composed of the same. In fig. 47 the ordinary structure of the tumor is represented; no alveolar arrangement was found in the true gliomatous tissue.<sup>a</sup>

The brain was not generally examined. Near the boundary of the tumor the blood vessels were dilated, filled with blood, and in the vicinity of some were accumulations of nuclei, and small hemorrhages were common. The boundaries of the tumor were indefinite; there appeared to be a gradual increase of nuclei or the neuroglia cells as the tumor structure was approached; these began to show elongated cell bodies, which gradually showed as large, irregular tumor cells, and the matrix became fibrillated.

In the uninvaded brain tissue the glia cells were not numerous by ordinary stains. A few were found presenting the usual appearances of these elements. There was no increase of the usual spider cells in the vicinity of the tumor. The nerve cells showed degenerative changes and some enlargement of the pericellular spaces in the portions adjoining the tumor.

The lungs were not examined with the microscope. The spleen showed some chronic passive hyperæmia. Kidneys contained a decided increase of connective tissue. Liver showed slight passive hyperæmia.

#### CASE 1619.

##### GLIOMA OF BRAIN AND CAVERNOUS ANGIOMA OF THE LIVER.

W. L.; aged 49; male; white; single; soldier; nativity, Germany. The patient was admitted to the hospital June 12, 1885, suffering from acute maniacal symptoms with homicidal tendencies and delusions of suspicion. During the past five years the delusions were less prominent; he became silent, confused, forgetful, unable to express himself without great difficulty, and at last was completely aphasic. During the last two years of his life he grew more demented, the aphasia was more marked, and there was decided impairment of hearing. His sight was fair, but ophthalmoscopic examination was not made, as

<sup>a</sup> My friend, Dr. E. L. Opie, suggests that the epithelial-like cell groups may be inclusions, within the glioma, of ventricular epithelium. This is quite probable, as at one place the growth had reached the lining of the left lateral ventricle.

tumor of the brain was not suspected. Epileptiform seizures, without premonition, were frequent. Following these attacks there would be complete temporary paralysis of the right side of the body, and the patient would be confined to bed for several days. The last convulsion, which occurred March 21, 1902, was followed by persistent hicough, prolonged stupor, and greater enfeeblement, which remained until his death, April 8, 1902.

Autopsy twenty seven hours after death. Body fairly well nourished; rigor mortis present; some scars of scalp, produced by injuries received in falls during convulsions; small abscess of left ankle.

*Cranium.* Antero-posterior diameter of skull, 7½ inches; transverse, 6½ inches; shape asymmetrical, the left side being a little the larger; thickness normal; arterial depressions of left side large and deep; Pterion body at upper end of left middle meningeal artery unusually large. The dura mater was abnormally tense over the left frontal region and the subdural space was dry, and the surfaces of the membranes were sticky in this situation over the tumor.

Brain: Weight, 1,350 grams. Surface of the organ much compressed over the left anterior regions; convolutions flattened against the tense dura and skull bone. In other regions the pia contained a moderate amount of fluid and the convolutions showed some atrophy.

The cause of these conditions was found to be a large tumor situated in the interior of the left frontal lobe, probably originating in the white matter, and from its situation and appearance supposed to be a glioma. The brain was incised horizontally on a plane with the middle of the corpus callosum, a section which passed through the greatest diameter of the tumor. It was found to be a spheroidal growth about 2 inches in diameter, occupying the white matter and extending to the cortex, but not to the surface pia mater. The tumor had pressed backward the overhanging portions of the anterior border of the insula and had flattened the insular gyri. It had forced the basal ganglia, septum lucidum, and corpus callosum toward the right, and had increased the transverse diameter of the frontal end of the hemisphere fully one-third. The falx had been displaced laterally and was embedded in the median surface of the hemisphere, while the swollen convolutions of the opposite surface.

The exact extent of the brain involved could not be determined, as the boundaries of the tumor were not well defined. It seemed to be situated mainly anterior to the motor region of the brain, and the paralytic effects must have been from pressure. The third frontal, middle frontal convolution, and the white matter beneath them were directly invaded, and judging from the displacement of other parts, the motor gyri must have been profoundly injured by pressure. The cut surface of the tumor showed a pinkish gray color mottled by dark-red hemorrhagic areas. The consistence of the tumor tissue was a little denser than the normal brain, and that of the tissue in the vicinity was somewhat softer from edema.

A few small softenings were found in the lenticular nuclei, the results of atheroma of the cerebral arteries. No other gross lesions were found in any part of the brain, and the spinal cord so far as examined seemed normal.

Heart: Weight, 470 grams. Cavities of right side filled with dark clots; the valves were not disensed; left ventricle hypertrophied; cause not apparent. The aorta was normal.

*Thorax.*—Lungs: Weight of each, 700 grams. Pleuritic adhesions on both sides. Lungs oedematous and the posterior portions were partly solidified by an exudate probably inhaled from the bronchi.

*Abdomen.*—Spleen: Weight, 170 grams. The capsule was wrinkled; pulp, pale and soft.

Kidneys: Weight of each, 120 grams. The capsules were not abnormally adherent except along the lines showing traces of foetal lobulation. Some atrophy of the pyramids and slight increase of pelvic fat.

Bladder showed slight hypertrophy of the middle lobe of the prostate gland; no disease of the mucous membrane.

Liver: Weight of liver tissue, 1,500 grams; gall-bladder contained 30 c. c. of normal bile. A large cavernous angioma in the upper surface of the right lobe, and two of small size in the lobulus Spigelii. Otherwise the liver seemed normal.

Other organs showed nothing of importance.

#### MICROSCOPICAL EXAMINATION.

The tumor proved to be a glioma of the astrocytic type though the tissue varied somewhat in structure in different regions. In the typical portions the cells were of almost all shapes and sizes, and whole fields were made up of branched cells and fibers. Some regions were composed mainly of round cells of uncertain character, lying in a fibrillated matrix and supplied with thin-walled vessels, and again, other fields were richly vascular with a stroma consisting of fibrous tissue with elongated nuclei resembling those of spindle cells. Areas of degenerations were found in all parts of the tumor. These regions seemed to be made up mainly of granular round cells with scanty stroma and a few persistent thin-walled vessels. The richly vascular regions are somewhat hard to explain. They may be primarily areas of connective tissue such as are found in these tumors, with telangiectasia affecting the capillaries especially.

The drawings represent the various modifications of the tissue and a field at the edge of one of the cysts of softening found in some parts of the growth.

The angioma presented no marked peculiarities.

#### SERIES III. SARCOMATA.

Intermediate between the gliomata and the ordinary sarcomata I have placed the tumor found in case 820, represented by Pl. XIX, and fig. 53. The tumor may be regarded either as a small-celled glioma, or, on account of the number of apparently mesodermic nuclei present, a glio-sarcoma or combination tumor. The nuclei, or round cells seem to have some relation to the vessel walls, so that in some respects it resembles a perithelial round-celled sarcoma.

The ordinary sarcomata are represented in this collection by one typical tumor, a small, round-celled sarcoma, which seemed to have originated in the neighborhood of the corpora quadrigemina and thence spread to the subthalamie region, cerebellum, peduncles, and into the posterior horns of the lateral ventricles as fungous masses.

The cellular structure of the tumor presented no marked peculiarities except unusual vascularity in some regions suggesting angio-sarcoma.



In some of the sections examined were large bands of mature connective tissue of uncertain derivation, possibly remnants of the pia mater.

Some of the blood vessels had thick, fibrous, and hyaline walls, though those in the midst of the cellular tissue had walls composed of flattened endothelium of sarcomatous cells and sometimes a few investing fibrils of connective tissue.

Some parts of the tumor were considerably degenerated, and in such regions an occasional mulberry concretion was found. These must be of different origin from those found in the dural endotheliomata, as there are no cells in the present tumor capable of forming spherical cell groups. Figure 56 shows two of these concretions lying at the edge of one of the broad connective tissue bands. They exactly resemble those found in the pineal gland, choroid plexuses, and in the true "brain sand" tumor, or psammoma.

#### CASE 820.

##### GLIO-SARCOMA OF BRAIN.

H. F.; aged 57; married; carpenter; late soldier; nativity, United States. The history previous to admission is imperfect, but shows that the patient was admitted to the National Home for Disabled Volunteer Soldiers, Dayton, Ohio, March 17, 1890, with epilepsy and mental impairment. At the time of his admission to the Government Hospital for the Insane, December 31, 1890, he showed some dementia, was harmless, but his mental impairment necessitated restraint. He was neat and tidy; would talk pleasantly, but with some mental effort to collect his thoughts. His habits were temperate, and his family history was good. After remaining in the hospital about four months he was sent to Hampton as "improved," but was returned February 19, 1892, and remained until his death, which occurred April 5, 1894. During his stay in the hospital he had convulsive attacks at intervals of about a week, but no other symptoms of brain tumor were observed. The case was entered on the hospital records as chronic epileptic dementia, duration over five years.

Autopsy, twenty-nine hours after death. Body well nourished; rigor mortis present. Only the brain examined.

*Cranium.*—Antero-posterior diameter, 7½ inches; transverse, 5½ inches. Skull quite thick and dense; sutures partly united; some prominence of inner surface in the region of the coronal suture; shape of skull at line of section nearly oval and quite symmetrical. On removing the calvaria the dura separated readily from the bone, but was slightly adherent to the pia mater over the left temporal lobe.

Brain: Weight of right half, 23 ounces (652.05 grams); left half, 28½ ounces (815.06 grams). The organ showed the effects of great intracranial pressure; the convolutions were flattened against the dura, and the subdural space was nearly dry. The pia mater was generally normal, but there were some subpial ecchymoses over the lower part of the central convolutions and posterior part of the third frontal convolution of right side, and ecchymoses and superficial softenings over the temporal lobe and lower portion of the central convolutions of left hemisphere. Almost the whole of the surface of the left temporal lobe was very soft, brownish in patches, and blotched with small hemorrhages.

On the left side the lower and anterior portion of the temporal lobe, the Island of Reil, and the anterior half of the basal portion of the hemisphere were dark red in color, swollen, pulpy, and irregular and tuberculated on the surface. The convolutions of the insula were much distorted by the swelling, and the arteries were deeply embedded in the depressions between them. The uncinate gyrus had swollen into a flocculus of pulpy tissue, which projected inward as far as the median line, overhanging the crus, optic tracts, and cerebral vessels. A small portion of the mass projected beneath the posterior communicating artery. A depression made by the wing of the sphenoid bone indented the swollen mass. The optic nerves and tracts were pushed toward the right, the crus was slightly flattened, and the third nerve was stretched somewhat over the tumor mass, and was slightly grayish in color. The posterior cerebral artery was displaced and its branches were deeply embedded in the swollen brain substance. On the median surface of the hemisphere the brain substance was pressed beneath the falx at least half an inch beyond the median line and the projecting portion had embedded itself in the opposite hemisphere.

On dissection of the brain it was found that the changes were more extensive than appeared on the surface. A large tumor mass occupied the interior of the temporal lobe, and apparently infiltration of the brain substance had extended in every direction. The root of the olfactory tract appeared to be affected, the posterior portion of the optic tract showed a reddish appearance unlike the normal, and the third frontal convolution seemed to be slightly infiltrated at its posterior portion. The exact boundaries of the infiltration could not be determined with the naked eye, as the general contour and color of the brain were but slightly changed at the supposed periphery of the growth. The cortex over the whole affected region of the brain was thicker than normal and darker in color, and the white matter was a reddish gray color, somewhat like the cortex. The tumor tissue was very soft and friable at the supposed central portion of the growth, but at the periphery the tissue gradually assumed the consistence of the brain substance. The growth extended deeply into the brain in every direction, the whole depth of the temporal lobe, the cortex and white substance of the Island of Reil, the posterior border of the third frontal convolution, and the posterior portions of the orbital convolutions all showed signs of infiltration. The ventricle wall, the fornix, and septum lucidum were displaced toward the right. The vessels at the base were considerably displaced by the growth and showed small patches of opacity.

The general consistence of the brain was much reduced, the tissue was oedematous, and the perivascular spaces were visible to the naked eye. The cerebellum, pons, medulla oblongata, and the cervical portion of the spinal cord removed with the brain, presented no gross changes.

#### MICROSCOPICAL EXAMINATION.

The tumor proved to be a glio-sarcoma. The cells are seen to vary greatly in size and shape, and seem to be arranged in groups, probably having some relation to the distribution of capillary blood vessels. The cells are round, oval, and elongated, and a few were found to have delicate processes radiating from them. The cell bodies, as a rule, are hard to distinguish, so that they appeared like sin

lying in a granular or faintly fibrillated matrix substance. In hardened sections the intercellular substance presents a granular appearance, very similar to the gray matter of the brain.

The cell growth extends into the brain substance in every direction; sometimes converting it into a cellular tissue; sometimes leaving the nerve-cells and other normal brain structures distinguishable. When the cortex is involved the outer layer seems to be more affected than portions lower down. A curious feature in some areas is the invasion of the enlarged pericellular spaces by the tumor cells; sometimes the nerve-cells are literally crowded out by the invading cells. In some convolutions invaded by the tumor cells the neuroglia of the gray matter seems to be coarsely fibrous, and many spider cells are found, but it does not seem that these cells enter to any great extent into the growth of the tumor.

In some parts of the tumor large, tortuous, thin-walled blood vessels are very numerous, giving almost a cavernous appearance to that portion of the growth. Capillary vessels are very numerous in some areas, some small hemorrhages are found, and occasionally a tortuous vessel with some pigment and an abnormal number of nuclei in its perivascular space.

The nerve-cells generally show some degeneration, but the shapes of the cell bodies are well preserved, even in sections bordering on the tumor. In the swollen convolutions the nuclear network seems coarser, and the protoplasm of the cell bodies is granular and often pigmented.

#### CASE 1237.

##### SMALL ROUND-CELLED SARCOMA OF THE BRAIN.

C. E. M.; aged 53; white; married; messenger in War Department, United States; nativity, Maryland. Mental disease, chronic dementia from tumor of the brain, duration unknown. The early symptoms in this case were depression, loss of memory, inattention to duties, and delusions of apprehension. He was admitted to the Government Hospital for the Insane July 13, 1897, with the above history, his mental failure advanced. His symptoms gradually became worse; he became bedridden, very weak, emaciated, and had numerous bed sores. He suffered from persistent headache, had attacks of vertigo, and occasional vomiting. His speech was incoherent; the pupils were dilated; there was ptosis of both eyelids; he became totally blind, and partially deaf. The temperature was persistently above the normal; he had constipation alternating with diarrhea; the urine was at times retained; finally the discharges became involuntary. December 24, 1897, he died from exhaustion. The duration of the disease could not be determined.

Autopsy seventeen hours after death. Body emaciated; evidences of bed sores over sacrum, and trochanters; rigor mortis present.

*Cranium.*—Antero-posterior diameter of the skull  $7\frac{1}{2}$  inches; transverse,  $5\frac{1}{4}$  inches. Sutures normal; shape symmetrical; bone of usual thickness. Dura mater was not generally abnormally adherent, but in the anterior portions of the middle cerebral fossæ the bone was absorbed in little depressions, and into these the dura, pia, and brain cortex had been forced by intracranial pressure as small hernias.

Brain: Weight, with the tumor, 48 ounces (1360 grams). The subdural space was somewhat drier than usual. The dura mater was

drawn tightly over the brain by intracranial tension. The arteries at the base were moderately full of blood but not diseased. The floor of the third ventricle was bulged downward, and the optic commissure was greatly thinned by the pressure of the intraventricular fluid; the optic nerves were smaller than normal. The brain was flabby and soft; convolutions somewhat shrunken and flattened at their summits by pressure against the dura mater and skull bone.

Dissection of the brain revealed a tumor growth, which appeared to have originated in the region of the corpora quadrigemina, and thence extensively invaded the brain. It had extended along the superior cerebellar peduncles and formed masses in the cerebellum; outward into the cerebral hemispheres and then involved the basal region at the junction of the occipital and temporal lobes, and grew into the posterior horns of the ventricles as fungoid masses. Small fungoid masses had extended forward along the lateral walls of the third ventricle. The corpora quadrigemina, conarium, valve of Vieussens, and upper part of the cerebellar peduncles were totally destroyed and indistinguishable. The complete obstruction of the aqueduct of Sylvius was no doubt the cause of the great distention and enlargement of the ventricles.

The tumor tissue was extremely soft and easily torn, and this, with the inflammatory adhesions, made the dissection very difficult. Section of the growth showed the tissue to be very vascular; reddish gray in color; somewhat degenerated in the central portions, and the knife came in contact with gritty particles in cutting through it.

When the tumor invaded the brain substance it was separated from the normal tissue by a definite boundary line, and when the growth penetrated pre-formed spaces, such as the posterior and inferior horns of the ventricles, the new growth seemed to conform to the shape of the space occupied.

In the vicinity of the tumor the brain substance was very soft and oedematous; tissue in general was pale; ventricles dilated; ependyma smooth; gray commissure was greatly stretched, but not torn. Nothing abnormal was noted in the medulla and spinal cord. Other organs were not examined.

#### MICROSCOPICAL EXAMINATION.

The tumor: The growth proved to be a small round-celled sarcoma, which probably originated in the membranes in the vicinity of the corpora quadrigemina. The great bulk of the tumor consisted of round cells, with relatively large nuclei and small protoplasmic cell bodies. The intercellular substance was scanty, appeared granular, but a few delicate fibers were found. Numerous sarcomatous blood vessels were found in the cellular tissue, in some places suggesting angio-sarcoma, and the grouping of the cells in the vicinity of the vessels, seen in some places, is also suggestive of some relation between the cell development and the vessels. Very little connective tissue was found in the main cell masses of the tumor, but in the vicinity of the pia mater some bands of fully developed fibrous tissue were found, which were supposed to be distorted remnants of the membranes, incorporated with the sarcomatous growth. Some large blood vessels were found in this tissue. In the degenerated areas of the tumor, where the gritty particles were detected by the knife, were numerous

irregularly rounded, concentrically striated, and sometimes mulberry shaped, highly refractile bodies, supposed to be what is commonly called "brain sand." They are supposed by the writer to be of different structure and origin from the somewhat similar spherules found in many of the spindle-celled sarcomata of the dura mater. (See description of fig. 56.) The calcareous spherules were not found in the cell tissue of the growth except in the degenerated areas, where they were associated with remnants of connective tissue. Some granular calcareous infiltration was found in the small cerebral vessels at the boundaries of the invading tumor. Though the tumor undoubtedly extended locally by invasion and infiltration of adjacent tissue, the microscope showed remarkably defined limits to the growth where normal tissue was invaded. The boundary line of the growth was often distinct, even when the pia mater was the tissue in advance of the growth. In this respect this tumor presented a marked contrast with glioma and glio-sarcomata, as in these no definite boundaries can be made out.

Brain: The membranes generally were normal. The blood vessels were somewhat tortuous and had some pigment granules in their perivascular spaces, but were not otherwise diseased. The brain cells showed various degrees of granular pigmentary degeneration. The cells of cerebellum and spinal cord were pigmented, and some in the latter were quite granular.

#### SERIES IV. HYPOPHYSEAL TUMORS.

Three tumors of the collection occupied the pituitary fossæ, two were adenomata of the hypophysis, and one was situated in the fossa and had greatly enlarged it, but did not involve the pituitary gland.

In the two cases of adenoma the tumors were large and had greatly enlarged the pituitary fossæ, and had pressed injuriously upon the structures in the vicinity and the brain; yet in neither case were there any signs of acromegaly, myxœdema, or allied conditions. So far as could be determined the thyroid glands were normal in all of the cases.

In the study of these tumors, made some time ago, the writer has not been able to satisfy himself as to the chromophilic character of the cells; but the marked differences in the size, shape, and arrangement of the cells in the normal gland were surprisingly repeated in the tumor found in case 788. A marked characteristic of this tumor, in which it differs from the normal gland and from the tumor to follow, was in the development of papillary ingrowths from the alveolar walls. In some regions the papillæ were so elongated and ramified as to almost fill the large acini. In some parts of the growth the alveolar spaces were very large, and were completely filled with small rounded cells, giving to the tissue a superficial resemblance to alveolar sarcoma.

In case 870 there was little tendency to development of papillary growths. The alveoli were very large and lined with long columnar cells, sometimes more than one layer deep, the more superficial cells lying wedged between the deeper layers. Usually some free cell was found in the central portions of the alveoli, and transverse view of the columnar cells presented the appearance of pavement epithelium in some parts of acini so sectioned.

The structure of this tumor appeared quite examined, and from the appearance of the cells

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I should conclude that the growth was composed almost exclusively of the large columnar type of cells such as are found at the posterior border of the prehypophysis. The cells stained deeply in eosin and appeared finely granular under high amplification, but so far as could be determined all were alike in staining reactions.

The connective-tissue stroma much resembled that of the normal gland, though the amount was relatively less, the alveoli being very large in both tumors. The stroma was well supplied with blood vessels and each papillary process contained one or more large vessels and a small amount of cellular connective tissue.

The third tumor of this series was completely degenerated, and its structure could not be determined. It had evidently been of considerable bulk, as the pituitary fossa was enlarged to at least four times the normal size. It was not a true tumor of the hypophysis, as the gland was found situated posterior to the growth and apparently normal. Though there must have been at one time during the growth of the tumor great pressure on and displacement of the structures in the pituitary region and the base of the brain, there were no signs of acromegalia in this case.

Though it is possible that obscure signs of the disease may have escaped the observation of the clinicians and the pathologist, we have here two cases of adenoma, or hyperplasia, of the hypophysis without the usual easily recognized signs and symptoms of a acromegalia, though the tumors had reached large size; and in the last case we have some evidence against the theory of pressure as a causative factor in the disease.

#### CASE 788.

##### ADENOMA OF THE PITUITARY BODY.

M. J. T.; aged 75; widow; domestic; colored; nativity, United States. Mental disease, chronic dementia, duration unknown. When she was admitted to the hospital she had a fair degree of mental power, which was retained during her stay in the hospital until about two weeks before her death. She had at that time a severe convulsion, followed by milder attacks for a few days; after this she became restless and excited, and so continued until her death. No ophthalmoscopic examination was made, but her attendants claim that she was totally blind for some time before she died. Some pain in the head was complained of, but it was not severe enough to elicit much complaint; vomiting was not observed during the time she was in the hospital.

Autopsy twelve hours after death. Body well nourished.

*Cranium.*—Antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse,  $5\frac{1}{2}$  inches. Skull rather thick, but not unusually so for a colored person; dura not abnormally adherent.

Brain: Weight, 43 ounces (1,219.05 grams). On removing the brain a tumor of globular shape was found at the base, projecting from the pituitary fossa. The tumor was nearly an inch and a fourth in its average diameter, and was irregularly globular in shape. The pituitary fossa was greatly enlarged to accommodate it; the antero-posterior diameter was an inch and an eighth, the transverse was an inch and a quarter, the depth three-fourths of an inch. The anterior clinoid processes could be distinguished, but the posterior pair were destroyed by the growth of the tumor. The bottom of the fossa and

the anterior portion of the basilar process showed the effects of absorption, and the dura mater at the bottom of the fossa was partly destroyed. On removing the tumor from the fossa the left cavernous sinus was opened and a portion of the carotid artery adhered to the tumor, showing that pressure must have been exerted upon the contents of the cavernous sinus.

The tumor had embedded itself in the base of the brain in the center of the circle of Willis, and a careful removal of it showed that it took the place of the pituitary body, and the depression in the brain was over the normal situation of that body. The depression in the brain was about half an inch in depth and an inch and a quarter in diameter. The optic nerves, chiasma, and the anterior position of the optic tracts were flattened out and the nerves were nearly cut off by being pressed against the anterior cerebral arteries. The vessels composing the circle of Willis were all thrust out of place by the tumor; the corpora albicantia were flattened slightly; the floor of the third ventricle was pushed upward; the roots of the olfactory nerves were pressed apart, and there was slight pressure on the crura cerebri. A portion of the tuber cinereum could still be seen at the bottom of the depression, and a band of tissue from it joined to the tumor; removal of the tumor brought away the band and thereby opened the third ventricle. The tumor was believed to be an adenoma, or overgrowth of the pituitary body, and such it proved to be on further examination. Section of the growth showed it to be composed of soft, pale, reddish-gray tissue, apparently of similar composition throughout. The tissue was quite moist, but no actual juice exuded from it. It had a distinct fibrous capsule, in which large blood vessels could be seen, and the growth was supplied with blood in the same way as the normal body.

The specimen was deemed of sufficient importance to justify a sacrifice of the brain, which would probably only show the usual degenerative changes, and therefore it was preserved in alcohol as a museum specimen. The examination of the exterior of the brain showed slight general atrophy of the convolutions and the depression above described in the basal region; but there were no gross lesions of the cortex, and no effects of pressure were noticeable over the convexity.

*Thorax.*—Lungs: The left weighed 10 ounces (283.50 grams); right, 11½ ounces (326.02 grams). The appearances were perfectly normal.

Heart: Weight, 12½ ounces (354.37 grams). Pulmonary valves normal; edges of tricuspid valve a little thickened; aortic valves slightly thickened and contracted; mitral valve thickened at its edges, and had yellow patches at its base. Wall of right ventricle thin and encroached upon by the superficial fat.

*Abdomen.*—Spleen: Weight, 1½ ounces (42.52 grams). Capsule tense; tissue fibrous.

Kidneys: Weight of each, 3¼ ounces (92.13 grams). Capsules adherent; surfaces granular and cystic; cortex thin; pyramids atrophied. Urinary bladder normal.

Liver: Weight, 39½ ounces (1,119.82 grams). Capsule over right lobe adherent to the diaphragm; tissue normal; gall-bladder contained dark bile and a few small calculi.

Uterus and ovaries: On the anterior wall of the uterus was a pedunculated tumor, and two or more small intramural tumors were found in the body. The upper portion of the cervix was constricted and the cavity was dilated, and at the fundus was a cystic growth about an inch



in diameter. The position was that of retroflexion, and uterus and ovaries were adherent in the recto-uterine pouch. The uterine arteries were tortuous and rigid; the ovaries were atrophied.

Other organs were normal.

#### MICROSCOPICAL EXAMINATION.

The tumor was found to be an adenoma, or hypertrophy of the anterior or epithelial lobe of the pituitary body. Sections from normal adult hypophyses are represented by camera lucida drawings for comparison with those drawn to the same scale from the tumor. The different portions of the tumor varied so greatly in structure on account of peculiarities of growth, and probably differences of origin, that it seemed necessary to represent several fields for comparison. By comparing the tumor specimens with the normal it is easily seen that all the cell elements found in the tumor have their prototypes in the normal gland, and that even the arrangement of the normal is usually closely copied by the abnormal growth.

There are, however, points of difference due to irregular development and growth, which make the study of this tumor extremely interesting.

The simplest portion of the tumor for study is that which is found in the denser portion of the growth and presents an alveolar arrangement as shown in figs. 60, 61, and 62. By comparison with the normal the alveoli are seen to be larger, the connective tissue septa are larger, and the columnar cells around the periphery are more regularly developed in fig. 60. In fig. 61 the acini are larger, but they are almost perfect reproductions of the small-celled acini in fig. 57. from the normal. The duct-like acinus has its normal prototype in the ducts which are found in the normal at the posterior border of the anterior lobe, and represented in fig. 59, drawn from this region. Figure 62, from the tumor, represents alveoli without a trace of columnar cells around the periphery. This variety of tissue only exists in small areas here and there, through the tumor. This variety of tissue I think must have developed from alveoli with similar cells and cell arrangement seen in the normal in figs. 58 and 59. In the tumor such fields bear a striking resemblance to cancer. In the alveolar structure of the tumor no lumen is preserved, as a rule, whereas in the normal many of the acini show central openings.

The most remarkable deviation from the normal is found in the looser portions of the tumor, represented in figs. 63 and 64. This tissue shows whole fields made up of papillary and elongated and branched processes of fibrous tissue, surrounded by long columnar cells. That these ramifying processes are more or less cylindrical is shown by the transverse sections of them seen in figs. 63 and 64. The central core of fibrous tissue carries the blood vessels just as the septa do in the alveolar portion of the growth. The long cylindrical processes ramify and run in every direction, so that in sections they are cut in every possible way, as may be seen in fig. 63.

Between the papillary processes small roundish cells are found; in some fields the interpapillary spaces are completely filled up with the cells; in other regions the spaces are nearly empty, or probably contained fluid during life.

By examining fig. 60 carefully we may gain some insight into the mode of growth of these papillary processes. It will be seen that

small papillæ grow from the septa into the cavity of the alveoli among the cells. Now, if we imagine these alveolar spaces greatly enlarged, and the papillary processes growing into them in every direction among the loose cells, we would have a picture similar to parts of fig. 63. It is rather more probable that certain parts of the growth became cystic, and that the papillary processes grew into these cysts until they were completely filled up by them, and that the loose cells are products of cell proliferation which occurs later, either from the papillæ or from the original alveolar walls. Whatever may be the mode of growth of these papillary processes, the condition is a common one in the adenomata, especially the cystic kind.

It is interesting to observe that the tendency to colloid degeneration which exists in the normal pituitary body is seen in certain structures in the adenoma; compare figs. 59 and 61. The duct-like acini contain a faintly granular material which is supposed to be colloid, as in the thyroid gland.

In the adult pituitary bodies studied to compare with the adenoma, I have not been able to demonstrate cilia on the columnar cells lining the large duct-like cavities situated at the junction of the two lobes, but it is claimed that the cells are ciliated (Weichselbaum).

The brain was preserved as a museum specimen and was therefore not examined with the microscope.

The kidneys showed a decided degree of interstitial nephritis.

The uterine tumors were fibro-myomata, one of which was cystic.

The other organs presented nothing of especial interest in addition to the naked-eye diagnosis.

#### CASE 870.

##### ADENOMA OF THE PITUITARY BODY.

J. M. C.; aged 56 years; married; farmer; former soldier; nativity, United States. Mental disease, chronic dementia; duration about two years and nine months. This case was remarkable for the large size of the tumor; the absence, so far as could be ascertained, of the usual symptoms of intracranial growth, and the persistence of some degree of sight with great pressure-atrophy of optic nerves and chiasma. The following clinical history was furnished me by my colleague Dr. Foster:

"J. M. C. was admitted to the hospital December 6, 1893; died September 10, 1894. Condition, anæmic, feeble, apathetic, confined to bed; no thoracic or abdominal disease apparent. Knees flexed at right angles, with contracture of leg flexors. Complains of pain in knees; is contented to lie quietly in bed; has good appetite; mental processes slow and feeble; untidy in habits. The pupils were rather large and sluggish, but equal, and no external ocular paralysis existed.

"He could see sufficiently for his needs in his demented condition, being able to feed himself. Acuteness of vision was not tested.

"The knee pains were relieved by sodium salicylate and did not recur. He gradually failed and died without other symptoms than exhaustion.

"After his death it was learned by correspondence that five years before his admission his sight had failed until he could barely see, but not recognize a person standing in front of him. His chief complaint was of being tired and of back ache, the latter being attributed to an injury received while in the service.

"He did not complain of headache, and the usual symptoms of tumor of the brain were all wanting during his stay in the hospital; nor could any be recalled by his widow when questioned by letter. There were no symptoms whatever of acromegaly."

Autopsy thirteen hours after death: Body somewhat emaciated; skin anæmic and slightly yellowish; pubic and axillary regions devoid of hair; yellowish-brown patches of pigmentation over the lower extremities; bedsores over both trochanters.

*Cranium.*—The skull was of the usual thickness, and the bone was rather dense; the sutures, including the frontal, were visible externally but were indistinct in the inner table; arterial depressions well marked. The shape was slightly asymmetrical; antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse diameter,  $5\frac{1}{4}$  inches.

Removal of the brain revealed a large tumor occupying the position of the pituitary body, and the fossa was greatly enlarged. When the tumor was dissected out, the cavity measured  $1\frac{1}{2}$  inches antero-posteriorly,  $1\frac{3}{8}$  inches in transverse diameter, and about 1 inch in depth. The surface of the bone in and around the cavity was eroded and roughened by absorption, and the clinoid processes and normal borders of the fossa were destroyed in the same way.

The dura mater was somewhat thickened along the superior longitudinal sinus, but was not abnormally adherent to the bone except around the margins of the enlarged pituitary fossa.

Brain: The weight with the tumor was 48 ounces (1,360.80 grams). The pia mater showed opacity, thickening, and some unusual adhesion to the dura along the margins of the great longitudinal fissure, and some opacity over the whole convexity, especially along the veins. The pial veins were full of blood; arteries at the base were atheromatous and displaced by the tumor. The convolutions were somewhat atrophied over the fronto-parietal convexity, but there was no flattening of their summits nor other sign of increased intracranial tension, and the cerebro-spinal fluid was increased.

The tumor occupied the place of the pituitary body and appeared to be an enlargement of the same. It protruded from the base and penetrated deeply into the ventricular cavity of the brain. As nearly as could be determined, the growth measured  $1\frac{1}{2}$  inches in transverse diameter, 2 inches antero-posteriorly, and was about 2 inches in vertical diameter. Much the greater bulk of the tumor was outside the pituitary fossa and had penetrated the brain cavities, as may be seen in the median section of the brain. (Pl. XXV.)

The carotid and posterior communicating arteries were widely separated, and the nutrient systems of small vessels which arise from the carotid and other arteries over the anterior perforated spaces were partly drawn from their places. The optic nerves were flattened and the chiasma stretched over the tumor and greatly thinned, and the optic tracts were widely separated and flattened by the encroachment of the growth. The third nerves were slightly compressed between the tumor and the pons, and the inner and anterior portions of the crura were slightly indented. The parts which form the floor of the third ventricle were completely destroyed and the growth had extended upward into the ventricular cavity, pressed aside and embedded itself in the walls of the third ventricle and the thalami, and encroached upon the caudate nuclei posteriorly. The upper part of the tumor was almost in contact with

the under surface of the fornix, and the velum interpositum was slightly adherent to it. The optic nerves, chiasma, and arteries were adherent to the growth, and had to be dissected from it for complete examination. The roots of the olfactory tracts were widely separated but apparently not directly pressed upon.

The tumor seemed to have a firm connective tissue capsule, but the interior was of soft consistence generally, and a clear juice exuded from the cut surface. In the center was a small calcareous mass which was sectioned with difficulty.

After hardening, the surface of the section looked granular or felt-like, probably from abstraction of the juice and irregular shrinkage of the tissue elements. The halves of the brain were hardened without further section to show the tumor in situ.

The cerebellum, pons, and medulla showed nothing of importance so far as examined.

*Thorax.*—Weight of left lung, 21 ounces (595.35 grams); right lung, 24½ ounces (694.57 grams). Slight emphysema of anterior margin; posterior portions hypostatic; shallow scars of pleura at the apices.

Heart: Weight, 7½ ounces (205.53 grams). Superficial arteries tortuous. Pulmonary and tricuspid valves normal. Aortic valves normal except some fenestræ above line of contact; mitral valve slightly thickened but competent; chordæ tendinæ slightly thickened; summits of muscular papillæ fibrous; endocardium of both ventricles slightly opaque. Arch of aorta not diseased; some atheroma in the abdominal portion.

*Abdomen.*—Weight of spleen, 5½ ounces (155.92 grams); capsule smooth; pulp soft and somewhat slate-colored.

Kidneys: Weight of left, 5 ounces (141.75 grams); right, 3½ ounces (106.8 grams). Capsules adherent; surfaces granular; cortex thin; pyramids darker than normal. Urinary bladder normal.

Liver: Weight, 41½ ounces (1,169.43 grams). Capsule of right lobe slightly adherent to the diaphragm; liver tissue rather pale. Gall bladder contained an ounce of pale, watery bile.

Other abdominal organs were normal.

#### MICROSCOPICAL EXAMINATION.

**Tumor:** The growth consisted of an alveolar structure, with large spaces filled with cells and lined with a more or less perfect layer of long columnar cells. The spaces were large enough to be visible to the naked eye, after hardening had rendered them more distinct, thus giving a felt-like appearance to the cut surface, as may be seen in Pl. II.

The long columnar cells were very irregularly arranged along the alveolar walls, and were of all sizes and shapes. Some were long and narrow, some club-shaped, some wedge-shaped to fill the spaces between the long tapering cells, and some were apparently loosening from their attachment to the walls and becoming shortened and rounded like the free cells in the center of the alveoli. At some places the lining of columnar cells seemed to be absent and the polygonal central cells were in contact with the walls of the alveoli. In the central portions of the alveoli the cells were of all shapes, but the majority were more or less rounded with prominent round nuclei. Some alveoli were completely filled to the layer of parietal cells; some contained comparatively few. In nearly all a space existed between the central cells and the

columnar layer, probably due to shrinkage of the central mass in hardening. It seemed quite evident from the appearances of the columnar layer above described that the central cells had been shed off from the walls and had gradually accumulated within the alveoli.

There was little indication of papillary outgrowths from the alveolar walls; but, with this exception, the structure was identical with the pituitary adenoma described in the preceding case, and represented by fig. 60. This difference in mode of growth is extremely interesting, as it furnishes additional proof of the theory of the development of such papillomatous adenomata.

The alveolar walls were composed of well-developed fibrous connective tissue carrying numerous blood vessels. No degenerative changes were found in the portions examined, which did not include the small hardened mass described in the naked-eye examination. A few of the alveolar spaces contained some blood among the central cells.

As the specimens were preserved for their naked-eye appearances, the brain tissue was not examined. The other organs presented nothing of interest in addition to the conditions noted at the autopsy.

#### CASE 964.

##### TUMOR OF THE PITUITARY FOSSA, AND CYST-LIKE PROTRUSION OF THE FLOOR OF THE THIRD VENTRICLE.

F. J.; aged 38 years; colored; single; laborer; nativity, United States. Mental disease, chronic mania; duration, over twenty years. Terminal dementia was so far advanced in this case that but little could be elicited from him as to pain or other subjective sensations. He was paralyzed, had occasional convulsions, and vomiting was sometimes observed. He grew gradually weaker, the paralysis became more general, bed sores formed, and death occurred from exhaustion.

Autopsy sixteen hours after death. Body emaciated; bed sores over sacrum.

*Cranium.*—Antero-posterior diameter of the skull,  $7\frac{1}{2}$  inches; transverse,  $5\frac{1}{2}$  inches. Shape symmetrical, but rather long and narrow; thickness about as usual in the colored race. On the external surface of the right temporal bone was a low, flat exostosis of irregular shape. The Pacchionian depressions were large; arterial channels normal.

There was marked enlargement of the pituitary fossa and the cavity was occupied by a tumor, which was removed with the brain. The antero-posterior diameter of the fossa was three-fourths of an inch, the transverse 1 inch, and the depth five-eighths of an inch. The walls of the cavity were nearly smooth, but showed absorption of the bone and part of the clinoid processes. The dura mater was not abnormally adherent to the bone and showed nothing unusual except dryness of the subdural space, and the convolutions were pressed against its inner surface, indicating a marked degree of intracranial tension.

Brain: Weight, when the ventricles were emptied, 45 ounces (1,275.75 grams). The pial veins were engorged; membrane in other respects as usual. At the base a soft yellowish-white mass projected into the enlarged pituitary fossa. The tumor mass was removed with some difficulty, on account of its softness, and at the bottom of the cavity the pituitary body was found, still presenting about its usual size and appearance. The infundibulum was still distinguishable and connected the pituitary body with the mass above it. The growth had

forced the optic nerve and chiasma forward and spread the optic tracts apart at their anterior extremities. The sheaths of the nerves and chiasma were firmly adherent to the capsule of the tumor. The posterior portion of the tumor, the arteries, and other structures at the base were hidden by a large subarachnoid cyst, which extended backward as far as the middle of the pons and laterally covered over the space between the crura and the tumor in front. The cyst contained a sanguinolent fluid and a quantity of crystalline material of a yellowish color, which was found to be cholesterin. The cavity contained in all about half an ounce of fluid and crystals. The cyst was carefully opened and washed, to expose the vessels and structures beneath it; it was then found that the cavity communicated with a broken-down ragged cavity in the tumor mass. The cholesterin was probably derived from the degenerated tumor tissue, which was so soft as to be readily washed away with a stream of water.

The arteries on the left side were found to be adherent to the capsule of the growth; those on the right were not in contact with it, and the cranial nerves were not involved, except the optic sheaths, as above described.

When the subarachnoid cyst was emptied it was seen that the floor of the third ventricle was expanded and bulged outward, spreading the crura and optic tracts apart nearly two inches. The bulging floor of the ventricle seemed to be entirely distinct from the overlying subarachnoid cyst, though both probably had some relation to the tumor not clearly explainable. From within it seemed to be merely an excessive dilatation of that portion of the ventricular cavity, though the lateral ventricles were also greatly enlarged. The ependyma was smooth; veins prominent; no cause for the excessive accumulation of fluid was discovered.

Section of the tumor showed a soft, degenerated structure throughout and much breaking down of the central portions. The original size of the growth could only be conjectured by the size of the fossa from which it was taken. The pituitary body was normal in appearance to the naked eye.

The convolutions were somewhat flattened against the dura and were slightly atrophied. The cortex seemed thinner than normal at the summits of the convolutions; brain substance oedematous; consistence reduced; perivascular spaces enlarged, and tortuous vessels could be seen lying within them. No gross lesions were revealed by section, and the cerebellum, pons, and medulla showed nothing but the general condition of the brain substance above noted. Spinal cord seemed normal so far as examined.

*Thorax.*—Pleural cavities normal. Weight of left lung, 15 ounces (425.25 grams); right lung, 22 ounces (623.70 grams). Anterior margins emphysematous; posterior portions engorged and slightly solidified by a patchy exudate.

Heart: Weight, 8½ ounces (248.06 grams). Pulmonary valves normal; tricuspid valve admitted four fingers, but was otherwise normal. Aortic valves were slightly thickened and fenestrated above line of contact; mitral valve was a little thickened at its margins and had a few yellow patches at its base. The summits of the muscular papillae were fibrous; endocardium of left ventricle opaque; muscular tissue relaxed and soft. The aorta showed some atheroma throughout.

*Abdomen.*—Spleen weighed 3 ounces (85.05 grams); capsule wrinkled; pulp dark and fibrous.

Kidneys: Weight of left,  $4\frac{1}{2}$  ounces (134.66 grams); right,  $4\frac{1}{2}$  ounces (127.57 grams). Capsule of left thickened and adherent to the cortex; surface generally smooth, but showed some small depressions. Capsule of right was easily removed, and the organ contained more blood than the left; in other respects they were the same. Urinary bladder was normal.

Liver: Weight,  $24\frac{1}{2}$  ounces (701.66 grams). Surface smooth; tissue showed slight passive congestion. Gall-bladder normal.

Stomach, intestines, and other abdominal organs appeared normal.

#### MICROSCOPICAL EXAMINATION.

Tumor: The tissue of the growth was so degenerated that its nature could not be determined. The capsule consisted of fibrous tissue, but the central portions were composed of granular fatty debris of cells and crystals of cholesterin. The total degeneration of the growth suggested that it may have been gummatous, but there were no external or internal signs of syphilis except the small flat thickening on the temporal bone. The nature of the growth must then be undetermined, but that it originally was of considerable size and of denser consistence was probable from the enlargement it had caused in the pituitary fossa. That it was not an enlargement of the pituitary body itself was shown by the presence of that body in nearly its normal condition.

The brain tissue showed the effects of chronic œdema in the enlargement of the perivascular and pericellular spaces. The small arteries were frequently tortuous, and blood pigment and a few extra cells were found in the surrounding spaces. The nerve-cells showed various degrees of yellow granular degeneration. The cerebellum, pons, and medulla were not examined. The spinal cord was normal. The other organs presented nothing of interest in addition to the naked-eye appearances.

#### SERIES V. SPECIFIC GRANULOMATA.

The so-called granulomata have been uncommon in my autopsies. As has already been mentioned, no syphilitic growth of any size has been found in nearly 1,700 autopsies, among them many cases of syphilitic disease. Specific meningitis has been found, and many cases of specific arterial disease, but cerebral and spinal gummata have been conspicuously absent, even when tertiary lesions have existed in the liver and elsewhere. It may be mentioned in this connection that the later tertiary lesions of the skin and bones are comparatively rare among our patients, a fact which may be attributed to the more or less successful treatment of the disease among the soldiers and sailors while in the service.

#### TUBERCULOMA OF BRAIN.

But one case of tubercular tumor of the encephalon has come under my observation; in this instance multiple, and affecting both cerebrum and cerebellum. Tyson places tyroma first in order of frequency; Bramwell also places it first under the name of scrofulous tumor. It is probable that the statistics upon which these statements were based included persons of all ages, as tubercular tumor is comparatively common in children, but rare in adults. When found in any case it



is usually secondary to tubercular disease of the lungs or elsewhere, as it was in this.

Relatively few cases of tuberculosis of the membranes of the brain were found in my autopsies, infection of the central nervous organs being for some reason rare in adults. In the case described there were five tumors of the encephalon; three in the cerebrum, two in the cerebellum. They were all of moderate size, sharply circumscribed, and greatly degenerated in the interior. Plate XXVI represents the largest of the growths situated in the cerebellum near the vermis.

The growths were accompanied by tubercular meningitis, and were secondary to tuberculosis of the lungs, lymphatic glands, vertebræ, and other organs.

The histological features of these tumors were not characteristic nor well marked on account of degenerative changes.

The more rare forms of granulomatous growths have not occurred in my autopsies.

#### CASE 991.

##### A CASE OF EXTENSIVE TUBERCULAR DISEASE, WITH MULTIPLE TUMOR OF THE BRAIN.

B. F. B.; aged 49 years; married; laborer; late soldier; nativity, United States. Mental disease, chronic dementia; duration, four years. The following clinical history was furnished by Dr. Foster:

"B. F. B. was admitted September 3, 1892, from the Soldiers' Home. The records of the Home show that he was characterized on his admission there by 'imbecility' and a 'shuffling gait,' and that the patellar reflex was exaggerated. These symptoms, with bronchial respiration at the apex of right lung, were the only symptoms recorded prior to his admission to the Toner Building, in October, 1894. He then showed posterior angular projection of the second and third lumbar spinous processes and in the region of the tenth dorsal vertebra. There was tenderness of the entire dorsal and lumbar spine. He was suffering from pain in the lower extremities, and the latter presented marked muscular weakness, with diminished tactile sensibility. The pain in the legs was not constant, but, relieved by rest and counter-irritation along the spine, recurred paroxysmally. He had occasional attacks of vomiting, with moderate rise of temperature and pulse.

"Weakness and discomfort in moving compelled him to keep his bed during the last six months. Tuberculosis, which had been latent in the apex of the right lung, developed, affecting lungs, intestines, liver, kidneys, and brain; but without cough or expectoration. During the greater part of the time he expressed himself as comfortable, notwithstanding the severe spinal caries.

"The mental symptoms were simply those of intellectual weakness. He was able to manifest an interest in his diet, calling for such food as he fancied. He would occasionally speak of pain in his legs when questioned, but seemed to have a singular immunity from suffering until the last ten days of life.

"The pupils presented no abnormality, and there was no ocular, facial, or bulbar paralysis. He never complained of headache, and did not speak of giddiness. There was much apparent suffering during the last week of life, but hebetude appeared, deepening into stupor, and he was most of the time unconscious of his surroundings.

"The usual symptoms of brain tumor (except the vomiting, which was attributed to the spinal lesion) were all conspicuously absent. He had no hallucinations, delusions, or delirium. Dementia progressed noticeably during the last two or three months."

Autopsy four hours after death. Body emaciated; rigor mortis slight; tattooed designs on right forearm. Marked angular projection of the spinous processes of the second and third lumbar, and the ninth and tenth dorsal, vertebræ; some deformity of lower cervical and upper dorsal region, the first dorsal process being turned toward the left. Bedsores had formed over the dorsal and lumbar spinal projections.

*Cranium.*—Antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse,  $5\frac{1}{4}$  inches. The skull was very thick and dense, especially in the frontal and occipital regions. In the thickest place in the frontal bone it measured one-half inch; in the occipital region, three-fourths of an inch; in the temporal, three-eighths of an inch. The sutures were indistinct in the inner table, but visible externally; diploë scanty, especially in the regions of greatest density and thickness; shape fairly symmetrical; arterial depressions well marked. Dura mater not unusually adherent to the bone, but there were slight adhesions to the cerebellar pia mater over one of the tumors and to the pia over a small growth in the right occipital lobe. There were no indications of increased intracranial tension, and the cerebro-spinal fluid was excessive in quantity.

Brain: Weight of right hemisphere,  $15\frac{1}{2}$  ounces (439.42 grams); left, 16 ounces (453.60 grams); cerebellum, pons, and medulla,  $5\frac{1}{2}$  ounces (155.92 grams). The pia mater over the convexity was thickened, opaque, its meshes filled with serum, and the pial vessels were very tortuous. At the posterior extremity of the median surface of the right occipital lobe the pia was adherent to the falx major over a small area, corresponding with a flat irregular tubercular growth in the cortex. In the right cerebellar fossa the pia was adherent to the dura mater over a tumor mass hereafter to be described. At the base in the vicinity of the optic chiasma, tuber cinereum, crura, pons, and Sylvian fissures, the pia mater and arachnoid were thickened and matted together, and the vessels were studded with small whitish nodules, which were found to be miliary tubercles. The convolutions were greatly shrunken over the convexity and median surfaces; ventricles moderately enlarged. In the right ventricle a tumor, about one-fourth of an inch in diameter, was found in the head of the caudate nucleus, projecting slightly into the cavity. It was hard, greenish-yellow in color, indistinctly concentrically striated, and sharply circumscribed from the surrounding tissue. The section projected slightly from the soft brain substance around it, but the tumor could not be enucleated without tearing the brain tissue. On the left side a tumor of similar appearance, but about three-fourths of an inch in diameter, was found in the median surface of the frontal lobe, just anterior to the white commissure and below the genu of the corpus callosum. Section showed that the growth was apparently below the cortex, and that it had encroached upon the caudate and lenticular nuclei and the anterior extremity of the internal capsule. The small growth in the right occipital lobe, before mentioned, presented the same general appearances and was supposed to be of the same nature. The brain tissue was very pale, soft, and œdematous; perivascular spaces large.

In the right hemisphere of the cerebellum were two tumors similar in appearance to those found in the cerebrum. One was situated at the outer portion of the posterior border of the hemisphere just above the great horizontal fissure; the other was in the superior portion, near its junction with the middle lobe; each was about half an inch in diameter and nearly globular. The tumors appeared to be beneath the general cortical surface of the organ and to have pressed aside and taken the place of the nervous substance. They probably originated from some portion of the pia mater between the folia, and grew in every direction. The outer one had reached the surface and became adherent to pia and dura mater; the other had a thin layer of cortex over its most projecting portion. Section of the left hemisphere, pons, medulla, and upper cervical spinal cord revealed nothing of importance in addition to the general condition of the brain substance above noted.

*Thorax.*—Firm pleuritic adhesions on both sides; right pleural cavity entirely obliterated. Weight of right lung, 38 ounces (1,117.30 grams); left lung, 28½ ounces (807.97 grams); both were completely filled with tubercular nodules.

Heart: Weight, 9½ ounces (276.41 grams). Slight increase of pericardial fluid. Pulmonary valves normal; tricuspid valve normal. Aortic valves showed a little chronic thickening along line of contact; mitral valve a little thickened at its margins.

*Abdomen.*—Spleen: Weight, 12½ ounces (354.37 grams); capsule slightly wrinkled; pulp firm and rather pale. When tested with iodine it did not show the reaction for amyloid material, and no tubercles were visible to the naked eye.

Kidneys: Weight of left, 7½ ounces (205.53 grams); right, 5½ ounces (155.92 grams). The pelves were dilated and the left contained a deposit of thick pus from an abscess which communicated with it; a number of smaller deposits of pus were scattered throughout the organ. The right kidney was less affected, but numerous foci of purulent inflammation were found scattered everywhere through it. The capsules were slightly adherent; surfaces smooth except where the small abscesses were situated in the cortex. The lesions presented the characteristics of tubercular inflammation. The urinary bladder was dilated and the walls were hypertrophied.

Liver: Weight, 63 ounces (1,786.05 grams). The right lobe was marked by the ribs. The tissue presented a marked nutmeg appearance, probably due to passive congestion and fatty infiltration. Many small whitish nodules, supposed to be miliary tubercles, were found scattered through the tissue. The gall-bladder was normal.

Intestines: A moderate-sized ulcer was found in the ileum near the ileo-cæcal valve, and the edge of the valve was ulcerated. There were some large ulcers in the head of the colon, one very large and deep about 4 inches from the caput coli, and one 3 inches beyond the last. The vermiform appendix was ulcerated for about two-thirds of its length from the extremity and filled with pus.

The stomach appeared normal. Other abdominal organs presented no signs of disease.

Spinal column: When the spinal canal was exposed, marked curvature was observed in the dorsal and lumbar regions, where the spinous processes were prominent. These regions were found to correspond with extensive caries of the bodies of the vertebræ. In the lumbar region the bodies of the second and third lumbar vertebræ

were nearly destroyed, and large masses of necrotic bone were completely separated and lay with the thick pus deposits in the place of the vertebræ. In the dorsal region the spinal dura mater was thickened, adherent to the bone, and over its inner surface was a hemorrhagic false membrane. A small hemorrhage, outside of the spinal dura mater, was found over the site of the greatest dorsal curvature. From the posterior view of the spinal column it appeared that the carious region was about 3 inches in length in the dorsal region and 4 inches in the lumbar, but examination from the front revealed that the caries extended from the seventh dorsal vertebra to the sacrum and actually involved the upper portion of the sacrum and adjoining portions of the iliac bones. The carious regions in front were all continuous with each other, and large pus deposits, some liquid, some caseous, lay all along the track of the disease. The psoas and iliacus internus muscles of both sides were infiltrated with large pus accumulations, and that on the right side was almost ready to point in the groin, having reached Poupart's ligament. After removal of the overlying tissues it was found that many of the bodies of the vertebræ were extensively eroded, and that the body of the second lumbar was almost destroyed.

Examination of the spinal cord itself was not conclusive without the aid of the microscope, but it appeared softer in the regions of the greatest caries, and the membranes were thickened and adherent to the spinal canal in the dorsal region.

#### MICROSCOPICAL EXAMINATION.

The tumors of the brain presented the usual characteristics of tubercular tumor. These growths are essentially masses of tubercular tissue produced by the development and coalescence of vast numbers of miliary granulations which have their origin in the vessel walls. These miliary tubercles have the same essential structure wherever found, being composed of lymphoid cells, epithelioid cells, an imperfect intercellular reticulum, and giant cells, the last two constituents not being essential to the simplest form of miliary tubercular granulation.

In the formation of these tumor masses the miliary granulations coalesce; the original vessels are soon obliterated by destruction of their walls and thrombosis, and the new granulation vessels, if formed, rapidly disappear, so that the mass soon degenerates in its central portions. Surrounding the degenerated portion is a zone of more recent granulation tissue, which by continuous growth adds to the periphery of the mass, which thus extends in every direction from the center and to the naked eye presents a concentrically striated appearance.

In the central portions of the present tumors scarcely a trace of the original cellular structure could be distinguished. Around the periphery the cell structure became more evident, and some traces of tubercular granulations could be seen. In the sections examined no giant cells were discovered. A few vessels were found in the periphery of the tumors still filled with blood. In the granulation zone the vessels showed great accumulations of cells around their walls, and this infiltration was observed to extend along the vessel walls for some distance into the brain substance. Portions of the pia mater adjacent to the tumors were infiltrated with round cells, especially in the vicinity of the vessels.

The brain substance generally showed widened perivascular and pericellular spaces and some pigmentary and granular degeneration of the nerve cells. In the walls of the pial vessels at the base, and in many of the small cortical vessels in the same region, many tubercular granulations were found.

The tissue of the cerebellum showed nothing of interest, except in the vicinity of the tumors, as above noted.

The spinal cord has not yet been examined.

The other organs showed tubercular disease in all cases where the nodules and lesions were found with the naked eye. The bones were not examined, but the tubercular nature of the caries seemed self-evident.

## SERIES VI. ANEURISMS.

### CASE 805.

#### ANEURISM OF THE RIGHT MIDDLE CEREBRAL ARTERY AND OF THE ABDOMINAL AORTA.

T. S. C.; aged 64; widower; late soldier; nativity, United States; mental disease, chronic epileptic mania. This patient had convulsive attacks occasionally, which were believed to be epileptic; he was somewhat demented; was feeble, and kept in bed, but showed no distinct paralysis except ptosis of right eyelid. He had occasional attacks of vomiting, and a few days before he died the vomitus contained blood. The eyes were not examined with the ophthalmoscope, but sight was impaired. The duration of his mental trouble was over eighteen years. Death occurred in a convulsion, preceded by great prostration from hemorrhage.

Autopsy thirty hours after death. Body fairly well nourished; marked pallor of skin.

*Cranium.*—Antero-posterior diameter,  $7\frac{1}{4}$  inches; transverse,  $5\frac{1}{8}$  inches. Skull a little thicker than usual, and a few small exostoses were found on the inner surface of the frontal bone. The sutures were partly obliterated and the bone was dense. The right posterior clinoid process and a small portion of the adjoining dura were adherent to a tumor mass in the brain and were brought away with it.

Brain: Weight of right half,  $20\frac{1}{4}$  ounces (588.26 grams); left half,  $20\frac{1}{4}$  ounces (581.17 grams). Pia mater oedematous; veins moderately full of blood; arteries at the base atheromatous in patches, especially the vertebrals. Convolutions were moderately atrophied over the whole brain; no effects of pressure could be distinguished.

On the right side at the base a tumor mass was situated on the inner side of the uncinate gyrus and extended from the anterior border of the pons to the posterior border of the orbital convolutions. The tumor was about  $1\frac{1}{2}$  inches in its longest diameter; it was globular in shape and of firm consistence. The anterior extremity of the temporal lobe was pressed outward, the crus pressed upon and indented slightly, the middle cerebral artery was displaced forward, the posterior communicating artery was pressed inward, and the third nerve was displaced and stretched over the tumor. The anterior extremity of the tentorium was adherent to the capsule of the growth, and the two adhered firmly to the posterior clinoid process. The capsule of the tumor was calcareous and thick, and the accommodation of the parts around to it showed the growth to be of long standing.

Section revealed the true character of the tumor; it proved to be an aneurism which had formed on the middle cerebral artery at a point between the posterior communicating and the anterior choroid artery. The opening into the vessel was shown to be about one-sixteenth of an inch in diameter, and some blood still entered the aneurismal sac, though the cavity was nearly filled by dry, friable laminated clot. (The photograph shows the opening into the vessel and the appearance of the aneurismal contents.)

The brain tissue was very soft in the vicinity of the tumor, so that it was difficult to section it without displacement. The thalamus was encroached upon by the sac and pressed upward; the lenticular nucleus and the anterior portion of the internal capsule were pressed upward. The optic tract was almost completely destroyed at its posterior portion. The situation of the tumor was such that the main fibers of the internal capsule passed over and behind it, and the pressure upon the crus was slight; the absence of distinct paralysis is thus explained. The slow growth of the aneurism and its gradual cure by obliteration of the sac probably account for the absence of more definite symptoms. The brain tissue in general was reduced in consistence and œdematous, but there were no gross lesions elsewhere in the brain.

*Thorax.*—Firm pleuritic adhesions on both sides. Lungs: Weight of right, 21½ ounces (616.61 grams); left, 15 ounces (425.25 grams). The left lung showed some hypostasis posteriorly and some chronic scar-like nodules at the apex, possibly the remains of an arrested tuberculosis. On the right side, occupying the position of the lower lobe, was a large cyst-like cavity between the two layers of the pleura which had a capacity of nearly 2 pints. The cyst walls were about one-eighth of an inch in thickness, and were composed of tough, fibrous tissue. The contents of the cyst were yellowish serum, and shreddy, caseous material floating in the serum and adherent to the walls. The lower lobe of the lung was pressed upward and backward by the cyst, and a portion of the tissue may have been destroyed. The parietal pleura and the diaphragm were adherent to the cyst wall and had to be removed with it. The lung was not sectioned, but nothing abnormal could be found in the remaining portions.

Heart: Weight, 10½ ounces (297.67 grams). Valves of right side, normal; aortic valves thickened, calcareous, and all the contiguous edges of the segments were adherent so that the orifice was much narrowed; the aorta showed some atheroma; the mitral valve was slightly thickened at its margins; summits of the muscular papillæ fibrous.

*Abdomen.*—Spleen: Weight, 4 ounces (113.40 grams); capsule wrinkled; pulp pale and fibrous; splenic artery very calcareous.

Kidneys: Weight of left, 3½ ounces (99.22 grams); right, 2½ ounces (63.78 grams). The pelvis of the left contained several fragments of calculi, which may have originally been one large calculus broken in removal of the organ. The capsules adhered slightly; surfaces granular; cortical substance extremely thin; several large cysts in each; pelvic fat increased; pyramids atrophied. The calices of the left kidney, its ureter, and the urinary bladder contained some gritty calcareous material and a little mucus.

Examination of the abdominal aorta revealed a small aneurism, about 1½ inches in diameter, which had formed on the vessel at the point where it is crossed by the duodenum. Adhesive inflammation had united the sac to the intestine, and rupture had occurred into the bowel.

ulum had formed in the interior of the intestine, which extended nearly the whole length of the small intestine from the point of perforation to the ileo-cæcal valve.

Other abdominal organs normal to the naked eye.

#### MICROSCOPICAL EXAMINATION.

Examination of the contents of the aneurism was not considered necessary. The brain-cells showed marked degenerative changes; some of the vessels were tortuous, and pigment was scattered along their walls.

The kidneys showed advanced interstitial nephritis.

Other organs not examined.

NOTE.—Though aneurism can not be properly considered as a tumor of the brain, the symptoms may be similar and the results the same. The subject of intracranial aneurism is treated with tumors of the brain by Bramwell and others, and the close association with the true neoplasms clinically will perhaps warrant the introduction of this case here.

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#### SERIES VII. OSTEOMATA.

Osteomata of the skull may penetrate the brain mechanically and interfere with its function, but such growths are usually small and flat and give no ante-mortem evidence of their presence. Osseous growths of this character have been quite common in my autopsies, but owing to the uncertainty as to their ætiology they have not been placed with the true neoplasms. Occasionally we meet with extensive nodular hyperostoses covering the inner surface of the skull bones, usually the frontal, such as shown in Pl. XXIX. As the exact relation of these growths to brain atrophy, to inflammation, and to developmental defects is not yet settled, they probably should not be considered as tumors. Though they are usually associated with extreme dementia and often with imbecility, the exact relation to the mental defect is hard to determine. The bone thickening has been regarded as compensatory to atrophy of the brain, but the condition is comparatively rare, while brain shrinkage is extremely common. It seems more probable that the process is set up during the period of development and that as a consequence normal cranial and cerebral growth does not occur. The dura mater is always adherent, thinned, and deficient over the roughened surface.

More common, but probably of less importance, are the small irregular flat masses of bone found usually in the falx. Though their ætiology is unsettled, they are probably errors of development and may be classed with tumors. Inflammation has been suggested as a cause, though this is hard to demonstrate. They are usually thin and flat, but are sometimes thick enough to make slight impressions in the adjoining surfaces of the brain. The dura over the mass is thin and defective, leaving small bone surfaces bare, and it is usually easy to enucleate the osseous growth. Signs of inflammation are usually wanting and they are not associated with any special form of mental disease. Pl. XXX shows a group of these growths from a number of cases, photographed the natural size.



## MULTIPLE TUMORS.

In several instances tumors of different character coexisted with the intracranial growths. These may be regarded as merely coincidences, as the growths were usually widely different in structure and situation, but as interesting associated conditions they may be here mentioned.

In case 853 there were several small wart-like growths on the dura and falx, besides the large tumor within the brain. These, however, were regarded as of the same origin as the cerebral growth, though the relationship was hard to demonstrate.

In case 1436 a small osteoma of the falx coexisted with a large dural endothelioma; in case 1146 a large soft cancer of the stomach with an endothelial sarcoma of the dura mater. A small papilliferous cyst adenoma was found in the kidney in case 1516, the intracranial growth being a small spindle-celled endothelial sarcoma. In case 1582 a dural endothelial growth was associated with a bulky hæmatoma, which would have complicated the diagnosis had tumor been suspected.

A medium-sized hemorrhagic spindle-celled sarcoma of the cerebellum found in case 1130 was associated with numerous soft fibromata of the skin. A possible relationship might be claimed in this instance, though microscopic examination failed to show any positive evidence of origin from the peripheral nerves.

In case 833 three tumors of widely different structure and situation, with evidently no ætiological relationship, were found at the autopsy. The intracranial growth was a small dural endothelioma, and the associated tumors were an adenoid cancer of the stomach and a round-celled sarcoma of the testicle with secondary deposits in other organs.

In case 1619 a cavernous angioma of the liver coexisted with glioma of the brain, and in case 788 a tumor of the hypophysis was found in an aged colored woman who had a number of uterine fibro-myomata. The degenerated tumor of the pituitary fossa, found in case 964, was associated with a large flat exostosis of the outer surface of the right temporal bone and moderate scaphoid deformity of the skull.

The tubercular tumors in case 991 were multiple, and in case 805 a large aneurism of a cerebral artery coexisted with a small one of the abdominal aorta which ruptured into the duodenum and caused death.

It will be observed that the more rare and less important intracranial tumors are not represented in the writer's collection. Psammo-sarcoma, and psammoma, tumors of doubtful character, are probably in many instances spindle-celled endothelial sarcomata with calcified and hyaline cell-spherules. Many tumors described as fibromata and fibro-sarcoma may probably be placed with the same class, as may certainly be many of those commonly called endothelioma.

The more uncommon forms of sarcoma, such as alveolar, melanotic, and perithelial types have not been met with in my autopsies.

Angioma has been reported as occurring in the brain, though care must be taken not to confuse this growth with telangiectasia of certain parts of gliomata and other tumors. Lipoma and chondroma have been found within the cranium, but must be exceedingly rare.

Primary carcinoma of the brain would of course be possible and secondary deposits may occur, though none have been found in the many cases of carcinoma of other organs examined by the writer.

With the exception of some large subarachnoid accumulations of fluid, no primary cerebral cysts have come under my observation.

The foregoing collection comprises all of the cases of intracranial growth in the 2,807 deaths which occurred in this hospital during the last eighteen years. Of the total number of cases 1,642 were examined, and, so far as could be determined clinically, all cases of intracranial tumor were included. When we recall that several of the tumors were small and so situated that they could have had no ætiological relation to the mental disease, the comparative infrequency of intracranial tumor as a cause of insanity becomes apparent.

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